CHEMICAL & METALLURGICAL ENGINEERING

Vol. 44 • ESTABLISHED 1902 • No. 10

CONTENTS FOR OCTOBER 1937

McGRAW-HILL PUBLISHING COMPANY, INC.

Publication office, 99-129 N. Broadway, Albany, N. Y., Editorial and executive offices, 330 West 42nd St., New York, N. Y. Cable address: McGrawhill, N. Y.

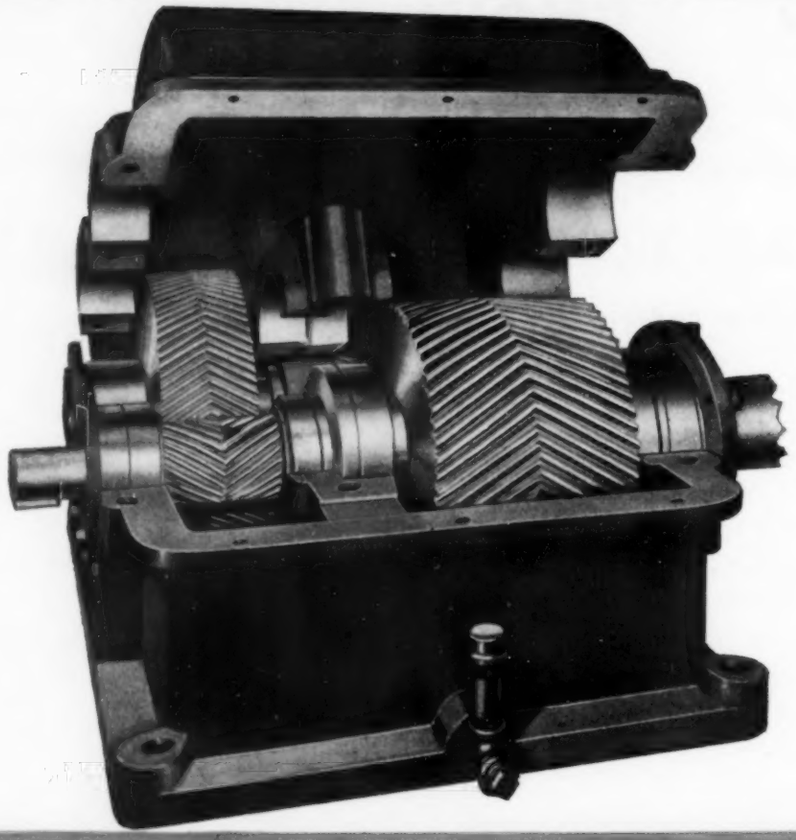
Branch Offices: 520 North Michigan Ave., Chicago; San Francisco; Aldwych House, Aldwych, London, W. C. 2; Washington; Philadelphia; Cleveland; Detroit; St. Louis; Boston; Atlanta.

JAMES H. McGRAW, JR., President
HOWARD EHRLICH, Exec. Vice-President
JAMES H. McGRAW, Honorary Chairman
L. F. STOLL, Vice-President
B. R. PUTNAM, Treasurer
D. C. McGRAW, Secretary
A. W. MORRISON, Circulation Mgr.

Published monthly, price 35 cents a copy. Subscription rates—United States, Canada, Mexico, and Central and South American countries, $3.00 a year. All other countries, $5.00 a year or 20 shillings. Entered as second-class matter September 2, 1936, at the Post Office at Albany, N. Y., under the Act of March 3, 1879. Printed in U. S. A.

Member A.B.C. Member A.B.P.

LINK-BELT



HERRINGBONE GEAR REDUCER

● Precision built and engineered — dependable, silent, durable — the Link-Belt Herringbone Gear Reducer is a worthy member of the Link-Belt positive drive group, which includes also reducers of the Worm and Motorized Helical Gear types, Silent and Roller Chain Drives, and Variable Speed Transmissions.

It is fully enclosed, compact, self-contained — built in a variety of sizes in single, double and triple reductions, in a large range of ratios and horse powers. Ability to withstand shock loads and conservation of space are outstanding qualities of this unit.

Link-Belt Company, Philadelphia, Chicago, Indianapolis, Atlanta, San Francisco and Toronto. Offices in principal cities. 3074

Send for these Books

Herringbone Gear Reducer Book No. 1519.

Motorized Helical Gear Reducer Book No. 1515.

Worm Gear Reducer Book No. 1524.

CHEMICAL
& METALLURGICAL
ENGINEERING
ESTABLISHED 1902

VOLUME 44 McGRAW-HILL PUBLISHING CO., INC. NUMBER 10

S. D. KIRKPATRICK, *Editor*

OCTOBER, 1937

No Embargo on Ideas

VISITORS returning from Germany last summer reported a change in attitude toward American chemical industry. Where once there had been the feeling that ours was a competitive activity that could succeed only at the expense of Germany's most important industry, its leaders now take a more realistic view. They realize that in many lines they cannot hope to compete either because our development has already surpassed theirs or because our tariff continues to serve as a barrier against the importation of most foreign goods. In turn their own embargos and exchange restrictions prevent them from buying our goods which they might otherwise pay for with chemical exports. All of this has taught one lesson, important to them as to us: Lacking ability to ship goods, the next best thing is to exchange ideas.

A wholly new trend has resulted. Inventions are no longer being kept as closely guarded secrets but are made available promptly for license or sale. Profits from such transactions in the United States are invested in this country or are used for the purchase of American ideas and processes. So a novel type of foreign trade has been inaugurated and is growing rapidly.

That Germany wants ideas and is willing to provide protection for them is evidenced by Paul Wooton's study of her unique patent system, on which he reports elsewhere in this issue. More than half of Germany's foreign patents are granted to Americans. Furthermore, many of these are being put to work. Only within the fortnight a synthetic rubber compound developed in the United States has been licensed for production in Germany. The same trend is evident in England where in the past few months a great deal of popular attention has been attracted by another rubber-like compound that has been in commercial production here for more than two years.

These facts are cited merely to remind us that this exchange of ideas is not a one-sided business. But the fact remains that we have much to learn from the older and longer established industries of Europe. Labor relations, pension plans and unemployment insurance are also among the subjects of timely interest right now.

By a happy arrangement with *Factory Management and Maintenance,* we are privileged to preprint in this issue an extended abstract of an unusual article by the Chief Labour Officer of Great Britain's largest chemical industry. One cannot read this without realizing how inexperienced we are in handling the problems of unionization, for example. English chemical manufacturers have dealt with these same unions for many years, gradually establishing the mutual responsibility and respect that lead to sound and stable labor relations. But we are impatient for, as Mr. Lloyd Roberts aptly remarked during his recent visit to this country, we are trying to accomplish in a matter of months, a social program that has taken decades to develop in England. He sees danger in ill-considered and impetuous development through legislative experiments such as the Wagner Law.

Exchange of ideas implies an open-mindedness which is becoming more evident among technical men all over the world. It is to our advantage to encourage and sustain that progress. The road of narrow nationalism leads only toward isolation and regression. We stand to gain more than we can lose if we deal openly and fairly with our foreign contemporaries and former competitors.

From an EDITORIAL VIEWPOINT

TO MONSANTO—THE AWARD FOR CHEMICAL ENGINEERING ACHIEVEMENT

OUTSTANDING among the developments in chemical engineering which have come into fruition since the last Chemical Exposition is the large-scale production and utilization of elemental phosphorus. A research program initiated by the Monsanto Chemical Company at its Anniston, Ala. plant in 1935, and later extended to its St. Louis and Dayton laboratories, culminated this summer in the successful design, construction and operation of a unique electric-furnace plant in Tennessee. Monsanto thereby becomes the nation's largest producer of phosphorus. Simultaneous research has also opened up a broad field of usefulness, literally a whole new chemistry of phosphorus in organic as well as inorganic combinations. Much more will be heard from this work in coming months.

By vote of the Committee of Award, made up of representative leaders of the industry and profession, Monsanto is to receive the 1937 Award for Chemical Engineering Achievement. Presentation is to be made by *Chemical & Metallurgical Engineering* at the close of the sixteenth National Exposition of Chemical Industries which is to be held in New York, Dec. 6–11. Next month it will be our privilege to present a well-illustrated article describing this group achievement and reflecting some of the philosophy of research and development that made it possible.

To Monsanto, our congratulations! To the Committee our deep appreciation for a difficult decision which we feel sure will be approved and roundly applauded by chemical industry and the chemical engineering profession.

EVERYONE WINS IN THIS CONTEST

BEST NEWS to come out of the Annual Safety Congress in Kansas City was that chemical industry has greatly improved even its own enviable record of safety. The first accident prevention competition for members of the Chemical Section of the National Safety Council was held from January 1 to June 30 of this year. Twenty plants out of 75 that enrolled produced perfect records, having no disabling injuries at all within the specified six months. During the period of the contest, between 25,000 and 30,000 employees of chemical plants worked over 35,000,000 man-hours. There were approximately seven disabling injuries per million man-hours or 32 per cent less than the average frequency rate for the entire industry during 1936. And, it is well to remember, that in 1936 the average accident frequency rate for chemical industry was 24 per cent below the average for all manufacturing industries.

The outstanding "no injury" record for the Chemical Section's contest was made by a Canadian company which worked 480,938 man-hours without a single disabling injury.

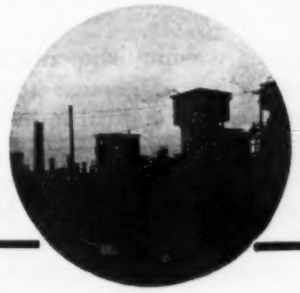
Chemical engineering progress demands safety in manufacture and distribution as well. While chemical industry is to be complimented for this year's record, we cannot afford to rest on our laurels. Next year we hope there will be even greater participation in this worthwhile national movement to reduce injuries to workers and to prevent reduction of engineering efficiency.

700 TIMES A PATENTEE

LAST YEAR when we celebrated the Centennial of the American Patent System, the committee in charge first called attention to the fact that Carleton Ellis, with 672 patents to his credit, stood third among American inventors holding the greatest number of U. S. patents. We are reliably informed that within the current month he will have received his seven-hundredth grant. To him this appears to be no occasion for celebration—yet from his many friends in the profession, a word of recognition and congratulation seems decidedly in order.

No other chemical inventor has ever approached this amazing number of patents. The Dreyfus brothers, Henry and Camile, working on artificial silk on opposite sides of the Atlantic, are runners-up, falling far short of the record set by the modest "miracle man of Montclair."

The facts of Carleton Ellis' brilliant career have been set down in intensely interesting fashion by Principal Examiner McFadyen in a biographical sketch appearing in the July, 1937, *Journal of the Patent Office Society*. To it we refer any reader who holds that there is no longer any great opportunity for discovery and invention in chemistry. Mr. Ellis has only started. He holds that the future development of synthetic materials is certain to go far beyond any present-day concept. He would have us begin where Nature leaves off and improve and adapt chemical creations to man's expanding needs. Would that his vision and the inspiration of his achievements might spread to every research organization!



IS BUSINESS BAD?

BUSINESS has the jitters. But business is not really bad. Far too much emphasis seemingly has been placed on the comparison of this year's production with last year's. The fact that the improvements from depression lows to the fair business of 1936 did not continue in the form of equal percentage improvements this year, has been given magnified and improper interpretation.

If business is no better than last year, then they say, "business is bad." This seems to have been a common conclusion. Even some chemical executives may have fallen into that error. It is a serious one, and should be zealously avoided.

On the other hand, there *is* some ground for concern among business men. It is a fact that profit margins are becoming narrower. Obviously *this* may be a legitimate cause for worry. Higher costs for raw materials, coal, freight, and labor, the prospectively larger burden of taxes, and the clamor for low prices encouraged by official action, are all a forecast of reduced profits. Thus far there is no serious implication of this sort for the chemical industries; but it is a threat to be considered.

Clear thinking, first, as to what makes *quantity* of business, and second, as to what makes *profitable* business, is essential. Confused thinking is bad for an individual, bad for his company, and bad for the public at large. Chemical engineers should study these relationships and use their influence constructively for a better understanding of the facts.

Business is not bad. It need not be bad. But bad thinking may engender bad business.

WANTED: MORE VICE PRESIDENTS

TWENTY or twenty-five years ago, labor was merely the concern of the plant foreman who simply "hired" it and "fired" it from day to day, and nobody thought anything about it unless and until there was a threat of a strike. After the War, labor became something of a problem and the plant superintendent employed a personnel manager to smooth out the difficulties. This arrangement worked fairly satisfactorily until recent years when the demands of labor upon management greatly increased. The employer-employee relationship has become so tremendously important that it now is or should be recognized as a responsibility of a high official of the company. In the case of a company employing a large number of workers, it should be the sole duty of that executive. He and his staff must be specialists trained in the knowledge of the problems of both labor and management. Labor can no longer be handled as a side line. It must be treated as a major issue with just as much concern as production and distribution.

CHARLES FREDERICK CHANDLER

CHEMICAL ADMIRERS from far and near are joining with Columbia University and the former students of Professor Charles Frederick Chandler in celebrating the centennial of the birth of that great chemist and great American. He entered a world that knew little of the science of chemistry. When he died, four score and ten years later, he left a world greatly enriched by his efforts. As an inspiration to young students he has probably had no equal. As a founder of the American Chemical Society and the Chemists' Club, and as president of the Society of Chemical Industry and many other organizations, Professor Chandler has had an enormous influence on chemistry and chemical industry.

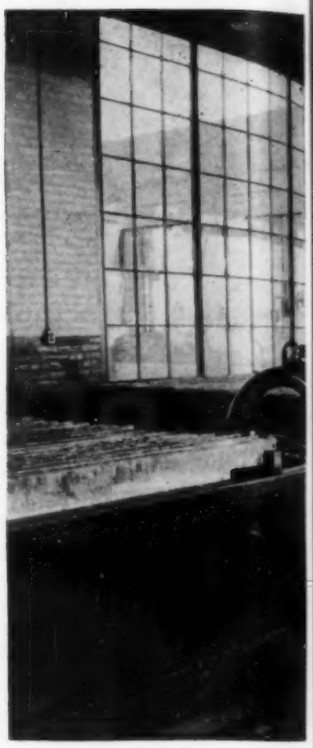
WESTERN PHOSPHATES UNPROMISING

WESTERN phosphates should be developed at new federal power projects of that territory, so says Senator Pope of Idaho. And he adds a threat on which he is quoted, in effect, as saying "I am advised that a number of foreign nations have agents in the United States who are endeavoring to secure control of the deposits and the processes for manufacturing phosphates." Thus the nationalistic red herring is drawn across the political exploitation trail.

Unfortunately, Providence placed these western phosphates in the Inter-Mountain country. They are of high quality. They can be processed by old and new methods. But they are too far from any market to warrant hauling them first to a processing plant and then shipping their products to the farmer or to a suitable point for export. Senator Pope's ideas are scarcely feasible; economic facts are against him.

And incidentally, any talk about foreign monopoly of domestic phosphate sounds strange to those who know the extent and character of these deposits. Chemical engineers do not expect even that rallying cry to furnish a basis for new western imitation of T.V.A. phosphoric acid processes—at least on the huge scale which Senator Pope would imply in immediate prospect.

TWO pioneering accomplishments distinguish this new plant for the electrolytic reduction of glucose to sorbitol and mannitol. Of most immediate interest to chemical industry is the fact that it makes available in commercial quantities and at an economical price a new group of useful raw materials which hitherto have been known as little more than laboratory curiosities. More interesting to the chemical engineer, however, and what ultimately may become of much more far-reaching significance in chemical process development, is the fact that it involves what is believed to be the first large-scale application of electrolytic reduction in the organic field.



SORBITOL From GLUCOSE By Electrolytic Reduction

By R. L. TAYLOR
ASSISTANT EDITOR, CHEM. & MET.

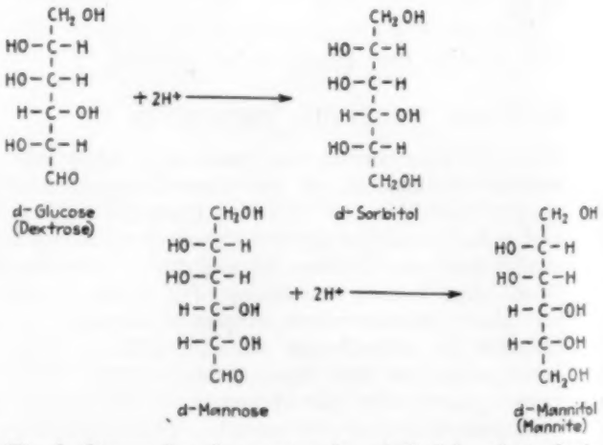
UNTIL VERY RECENTLY sorbitol was known to chemical engineers as little more than a rare curiosity that an occasional chemist kept tucked away on his laboratory shelf. It was found in small amounts in mountain ash berries, pears, cherries, apples and many other plants and could be bought for a price ranging anywhere from $300 to $500 a pound. Likewise mannitol—also called mannite—while known from Biblical times as the chief constituent of manna, sweetish exudate from the European ash and similar species, was of practically no importance outside of the medicinal field. What little was consumed there came entirely from the natural source and seldom sold for less than several dollars a pound.

During the recent depression, however, the Atlas Powder Co., desirous of diversifying its chemical manufacturing interests, undertook to investigate the commercial possibilities of the higher polyhydric alcohols from the standpoint of both quantity production and possible industrial uses. The result was the development of a synthetic process for making sorbitol and mannitol by the electrolytic reduction of corn sugar (*dextro*-glucose). Thus the contents of the dusty little bottle on the chemist's curio shelf became the chief concern of a group of Atlas engineers.

The process was developed in the company's laboratories at Stamford, Conn., where a pilot plant was operated on an experimental basis in 1935 and 1936. Demand increased so rapidly, however, that construction was pushed ahead during 1937 and a new $1,000,000 plant is now going into operation at Atlas Point, Del.

This is believed to be the first time that electrochemical reduction has been applied on a commercial scale to the production of organic chemicals—a fact which may seem rather strange in view of the many millions of dollars which have been spent on research, development and plants for electrolytic processes in the inorganic industries. With the increasing availability of cheap power on the one hand and the rapid development of pressure hydrogenation on the other, whether or not electrolysis will open up new roads into the field of industrial organic chemicals production is something which cannot be predicted.

The simple chemistry of the electrolytic reduction process and the stereo relationship between sorbitol and mannitol are seen from the following equations and structural formulas:



The hydrogen for the process is supplied by electrolysis of the water in the electrolyte solutions.

The new Atlas plant has been designed to produce a maximum of 250,000 lb. per month of any of the higher

Twelve specially designed electrolytic cells are used for reducing the glucose solution. Below:—Electrolyte temperature recorder

polyhydric alcohols from their corresponding carbohydrates. It is not limited to sorbitol and mannitol alone. But since these particular alcohols are the ones being made at present, the various steps of the process will be described in terms of their production.

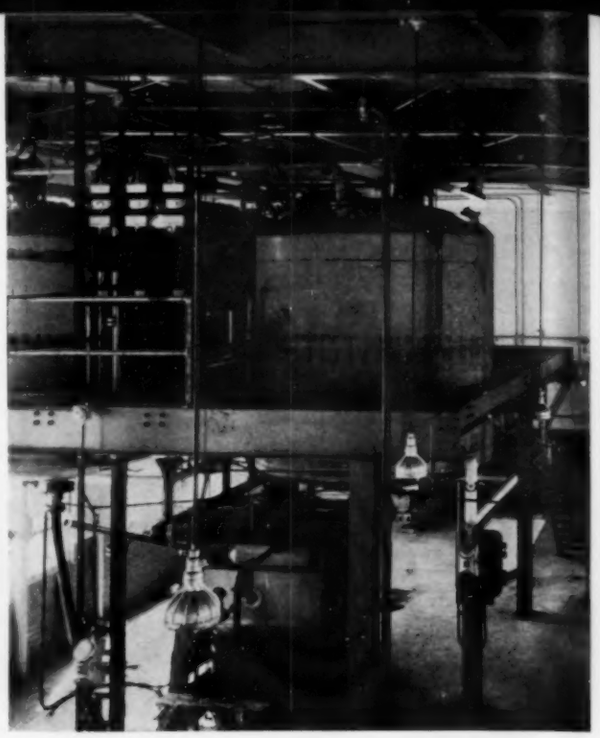
The process does not yet lend itself to continuous operation so all equipment and materials handling facilities are designed for batch work. Purified glucose (American corn sugar) the chief raw material, is shipped to the plant in 100-lb. cloth bags and is stored indoors until needed. In making up the batch, the required amount of glucose is simply emptied by hand from the bags into a 1700-gal. mechanically agitated dissolving tank into which enough distilled water is introduced to give a concentrated water solution. In this same tank the glucose solution is rendered alkaline by addition of sodium hydroxide and sodium sulphate in order to bring its electrical conductivity up to that required in the cells.

After this careful preparation in the dissolving tank the solution is pumped to one of the twelve electrolytic cells in the cell room. These are all of special construction, the design having been developed from a simple laboratory unit which from the standpoint of economy and effectiveness seemed to be best suited for this particular process. Each cell consists of an open-top rectangular tank about 13 ft. long, 6 ft. wide and 3 ft. deep in which are suspended alternately 35 anodes and 36 cathodes, each of which is in the form of a rectangular plate with dimensions corresponding to the width and depth of the tank. The anode is of pure lead while the cathode is a lead-mercury amalgam, the lead serving merely as a holder for the mercury electrode. Completely surrounding each anode is a diaphragm of unglazed porcelain which encloses the dilute sulphuric acid anolyte and keeps it apart from the glucose solution which serves as the catholyte. Direct current for the cells is supplied by four motor-generator units designed to deliver 5,000 amp. at 20 volts.

The electrolytic action in the cell is quite simple. The water in the two electrolyte solutions is decomposed by the current to liberate at the cathode nascent hydrogen which reduces the glucose to sorbitol and mannitol, and at the anode nascent oxygen which forms lead peroxide. This latter compound is recovered as a byproduct of the process.

For reducing various sugars to their corresponding alcohols, a time interval of from one to several weeks is necessary. The stereo arrangement of the alcohol molecule can be influenced by modifying the cell conditions.

One of the vital factors in the reduction process is temperature control. To facilitate this and in order to obtain better distributed and more intimate contact between the hydrogen and glucose, the glucose solution undergoing reduction is actually not retained in the cell all of the time but is circulated continuously through a cycle consisting of the cell and a double-pipe countercurrent cooling coil. The construction of the cell is such that it contains a baffle between every group of six pairs of electrode plates, so that with a total of 36 pairs of plates the solution entering at one end makes six passes back and forth across the width of the cell as it travels to the down pipe at the opposite end. During this time the temperature of the solution has increased several degrees above the approximate room temperature at which the reaction has been found to proceed most satisfactorily, and it is to bring it back to this temperature that it is run through the cooling coil before recycling through the cell. By means of recording thermometers a close check is



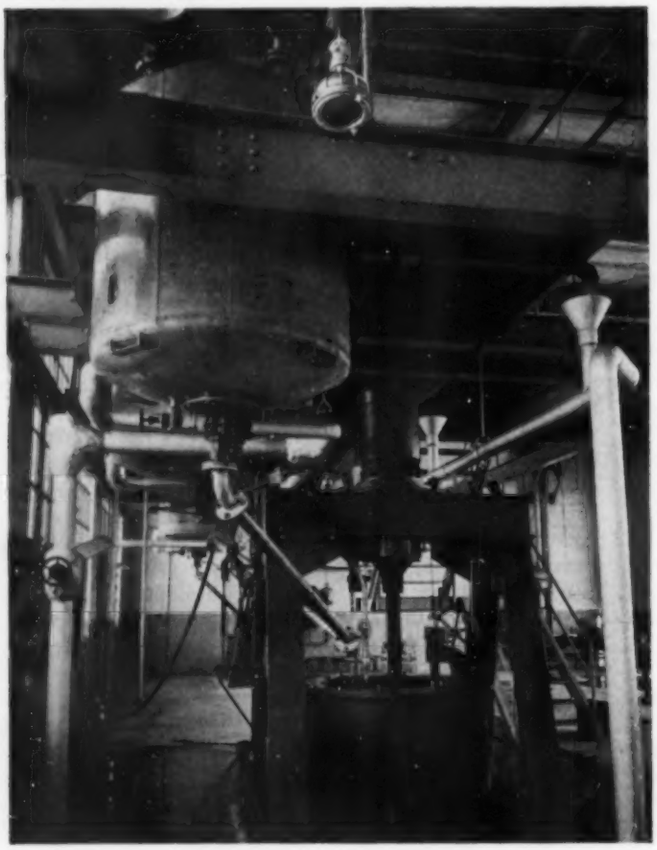
kept on temperatures of the solution while it is in the cell.

After reduction is complete the solution is pumped to a glass-lined, steam-jacketed vacuum kettle where the water is evaporated off, leaving a residue of mannitol, sorbitol and sodium sulphate. Hot ethyl alcohol is then introduced into the kettle and dissolves everything but the sodium sulphate. The sulphate is readily filtered out of the hot solution by means of a simple suction filter consisting of an ordinary cone-bottom receiver fitted with a filter medium supported on a wire screen in the bottom of the cone. The alcohol solution filtrate next goes to a crystallizer where it is chilled sufficiently to crystallize out all of the mannitol. The cold mixture is then dropped into a vertical basket-type centrifuge which recovers the mannitol crystals. As stated in an earlier paragraph, the yield of mannitol is dependent on conditions in the cell. These are deliberately varied to obtain the desired end results.

After centrifugal separation from the sorbitol solution the mannitol is re-dissolved in distilled water, crystallized and then centrifuged again. To obtain a still greater degree of purity the recrystallization process is repeated. The crystals are finally dried in a tray dryer, ground and barreled for shipment.

In the meantime the sorbitol solution from the centrifuge goes to a steam-jacketed kettle still where the alcohol is distilled off, condensed, and returned to a receiver from where it is reused in the first vacuum kettle for making up another alcohol solution of sorbitol and mannitol. The sorbitol, now in the form of a thick concentrated water solution—often called a syrup—is given a Darco activated carbon treatment for decolorizing and purifying, and is then filtered before drumming for shipment. The commercial syrup consists approximately of an 85 per cent water solution of sorbitol and contains as impurities small amounts of glucose and sodium sulphate.

Mannitol crystallizer and basket centrifugal



It has been found desirable to use either rubber- or glass-lined equipment throughout the process in order to avoid corrosion products which would contaminate and, what is considered still more serious, discolor the finished product. A number of common alloys have been considered which would be entirely satisfactory from the standpoint of endurance, but, because of the solvent power of polyhydric alcohols on metallic oxides plus the fact that a sugar in alkaline solution is always present, these have been found to cause rather serious discoloration of the final sorbitol solution. For that reason the electrolytic cells, receivers, mannitol crystallizer, pipe lines, evaporators, and centrifuge are all either glass- or rubber-lined.

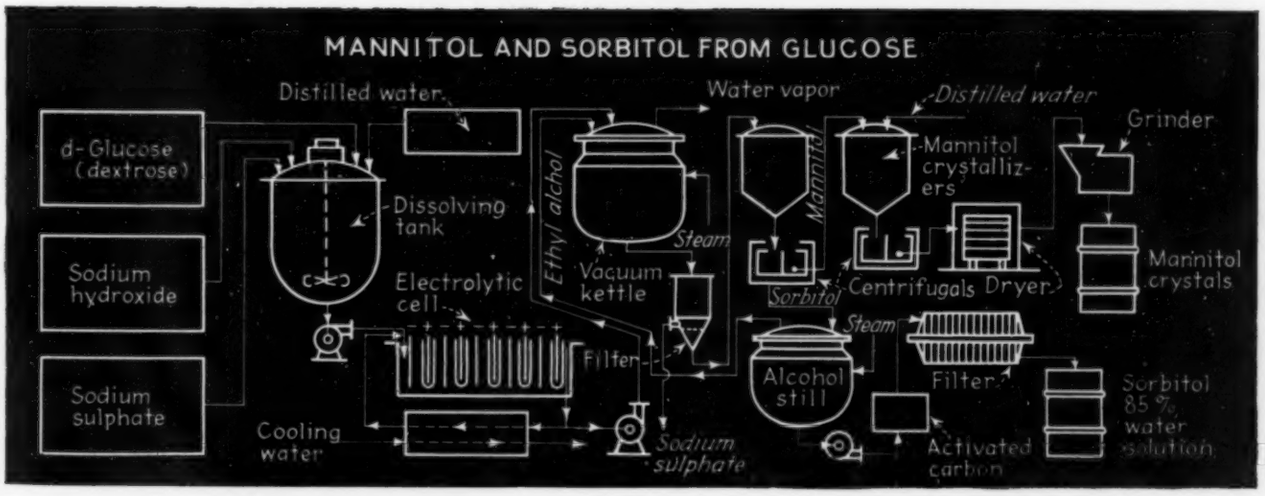
Worth mentioning as an outstanding feature of this new plant is the modern and well-planned electric wiring system. In a process where electricity plays such an important part it is necessary that maximum precaution be taken against line breaks which may mean costly interruptions of production. All conduits, motors and starting devices are either vapor proof or explosion proof installations. It is surprising, too, what a little good judgment in locating conduits can do for the appearance of a plant interior.

In view of the newness of the hexahydric alcohols as chemical raw materials, it is appropriate that their properties and uses be described here briefly. In general their characteristics differ only in degree from those of ethylene glycol,

All conduits, motors, starting devices and electric lights are either vapor proof or explosion proof installations

humidities it retains as much moisture and at high humidities picks up less moisture than does glycerine. For this reason its use as a conditioning agent for textiles, paper, regenerated cellulose sheets, leather and tobacco is expected to develop. Its humectant properties also make it a good plasticizer for vegetable adhesives, glue mixtures, and gelatine compositions. Also because of its six hydroxyl groups, sorbitol can be used as the starting point for a number of organic compounds. Its particular chemical configuration—of stereo characteristics—makes it useful in synthesizing compounds with similar configurations such as sorbose, the starting point in the synthesis of ascorbic acid (vitamin C).

Mannitol, in spite of being a stereo-isomer of sorbitol, has quite dissimilar properties. Mannitol is a crystalline solid melting at 166-167 deg. C., is soluble in hot



glycerine, and the other lower members of the polyhydric series.

Some of the physical properties of the 85 per cent water solution of sorbitol are as follows:

Specific gravity	1.35	
Viscosity at 25 deg. C.	7400	centipoises
Viscosity at 30 deg. C.	3500	centipoises
Refractive index at 25 deg. C.	1.48	
Solubility: In water	Good	
In 95 per cent alcohol	Good	

In comparison with a like concentration of glycerine, the specific gravity, viscosity and refractive index of sorbitol are all considerably higher. An interesting fact relative to the hygroscopicity of sorbitol is that it has a very narrow humectant range, i.e., range of variability of moisture content. It is claimed that at low water or hot alcohol, fairly soluble in cold water, slightly soluble in cold alcohol, and insoluble in most organic solvents. Its refractive index is about 1.345 and it is neutral to methyl orange.

The present uses of mannitol are in the medicinal and pharmaceutical fields and in the making of fancy papers and resins. A nitrogen derivative, nitro-mannite, has found a use in medicine and is claimed to have exceptionally favorable properties as a non-corroding primer for explosives.

Any very extensive commercial use of the higher polyhydric alcohols has in the past been limited by both price and supply. However, with a new and steady source of supply now made available, the way is cleared for an extension of known applications as well as research in entirely new fields.

Industrial Contributions To Employee Education

By W. L. ABRAMOWITZ
NATIONAL OIL PRODUCTS CO.
HARRISON, N. J.

TECHNICAL MEN, if their metal rings true, are rarely satisfied with the knowledge and skill which they have acquired. This paper summarizes the problems involved and the procedures undertaken by industry in supporting the efforts of its chemists and chemical engineers desirous of supplementing their education and training by further part-time schooling.

The young engineer emerging from college has in general had his fill of lectures and recitations. Before him stretches a promising vista of processes and inventions which he is going to effect with his science and skill. Enough of classrooms and of investigations conceived and solved on paper.

Our young friend finds his position and immerses himself in learning the fundamentals of his particular industry. His imagination is still on a high level. He reads the technical journals and attends professional society meetings religiously. But as time goes on, if he is an organic chemist, he finds that he is forgetting the engineering he may have known at graduation, most of his physical chemistry, and a large part of his general chemistry. If he is a chemical engineer, he finds that he is forgetting even the little organic he once knew.

His personal work becomes more and more exacting in its time requirements. Now he only thumbs through one or two of the journals. New developments, except as they occur in the narrow confines of his field, pass by in the urgency of immediate problems. The average man staying with the same company for years is likely to know "more and more about less and less."

How does all this affect the employer? The chemical industry is exceedingly motile. A firm which merely maintains a status quo is soon relegated to the background. If its research men are alert, awake to new ideas, new methods, and new equipment and able to apply these to old and to new problems, the firm will prosper. If the chemists are unable to make these applications, the employer loses.

Many of the leading chemical and engineering concerns have already established definite programs whereby men are encouraged to attend night courses in nearby colleges and universities, the company sharing in the expense. The percentage refunded to the individual is frequently varied with the grade obtained and averages $50 to $100 per year per person. Many companies refund the entire cost to the student if an *A* grade is obtained. A large eastern oil refinery advances the cost and arranges payroll deductions so that the amount will be liquidated upon completion of the course. A refund is then made amounting to 75 per cent of the cost.

Nevertheless, such a procedure is of particular value to men who are working toward a college degree. The majority of companies are quite liberal in extending a wide choice of courses, approve studies in modern languages, mathematics, and physics, and do not insist unduly that subjects be intimately related with company interests.

For advanced men another method of employee training which is finding increased favor is the summer school plan. Recently, for example, the Massachusetts Institute of Technology offered a five weeks course for industrial men in theoretical and applied colloid chemistry. Credits (equivalent to almost half of a normal semester's work) toward a graduate degree were given. As was to be expected, part of the attendance was drawn from the major chemical companies, but it was surprising to note how many smaller concerns thought it worth the expense to send men. One chemist came from as distant a region as Texas.

In participating in such courses, the technical man, liberated from the pressure of normal routine, is free to become engrossed in the new developments opened to him. Of further advantage are the contacts and friendships developing during this association with men from many fields and interests.

A third, although more rare *modus operandi*, is the scholarship or fellowship system whereby companies pick exceptional men from their own staffs for graduate training of one, two, or even three years. (This is to be distinguished from the customary practice of endowing awards at various schools whereby the college or university is left free to select promising young scientists.) With due respect to the employer's pocketbook, the men have generally selected problems of interest to the firm but still ones of fundamental nature. Several instances are known where doctorates have been obtained through company support.

A few companies have found it preferable to have the men divide their time between classroom and plant, as for example by working three days a week at the university and three days at the company plant or office.

Several research directors have raised the following pertinent questions: (a) Is it not as cheap and certainly simpler to hire Ph.D.'s directly? (b) What assurance does a company have that the employee, after being trained at company expense, will not go elsewhere? (c) Why put men in a position where they can demand substantial salary increases?

The general concensus of opinion appears to be that (a) the training of employees is an excellent supplement but not necessarily an alternative to hiring high priced men. A man fresh from industrial work is in a position to spot important applications and adaptations which might otherwise wait for years before being unearthed, and the viewpoint of a man combining dollar and cents industrial experience and applications with varying degrees of pure research is much more realistic and practical than that of a young Ph.D. emerging from class and lecture rooms. Further, a Ph.D. fresh from university research requires a certain amount of industrial experience and training before he can return full value to his employer. A period therefore exists during which the relatively high salary paid to him produces comparatively little yield. (b) A company which is progressive enough to contribute toward the education of its men need not fear for their loyalty. As for the last question, it is felt that if a man is worth cost of training and justifies the investment, it is not unreasonable to reward his enterprise.

Digesting Cellulose In Continuous System

THE CONTINUOUS DIGESTER invented by Joaquin de la Roza of Cuba was developed for the production of pulp for paper making. It was designed to process wood, cotton linters, sugar cane bagasse, bamboo, straw, cornstalks and other cellulose materials by any of the chemical or semi-chemical methods. However, its usefulness is not necessarily limited to this one industry for it offers possible applications outside of the field of pulp and paper.

One of the many advantages that are claimed for the continuous digester is accurate control of all of the factors required for the digestion of pulp. Other features include continuous impregnation of the chips with chemicals before cooking, continuous mixing, heating and circulating of the digester contents while cooking. The continuous removal of spent liquors at high temperatures, heat recovery and washing of the pulp are among the many other advantages that are said to result in the production of a far better quality and much more uniform pulp.

The complete pulp plant consists of an impregnating feeder, a press, a long horizontal rotating digester, two pulp presses, and heating, measuring, recording and controlling auxiliary equipment. In the case of materials such as wood, that may vary widely in moisture content, a moisture equalizing press must be included. In case the material to be processed is not sufficiently moist, hot water is added in the equalizing press. On the other hand, if the material is too wet, the excess water is pressed out.

The raw material charged into the system is controlled so that a predetermined weight enters in a given time. A continuous belt feeder scale is used for the purpose. It registers separately the bone dry weight of charge and the moisture content. From these amounts the cooling liquor may be determined, and the flow meter and liquor feed adjusted to the desired liquor ratio and quantity of chemical, water and dry raw material.

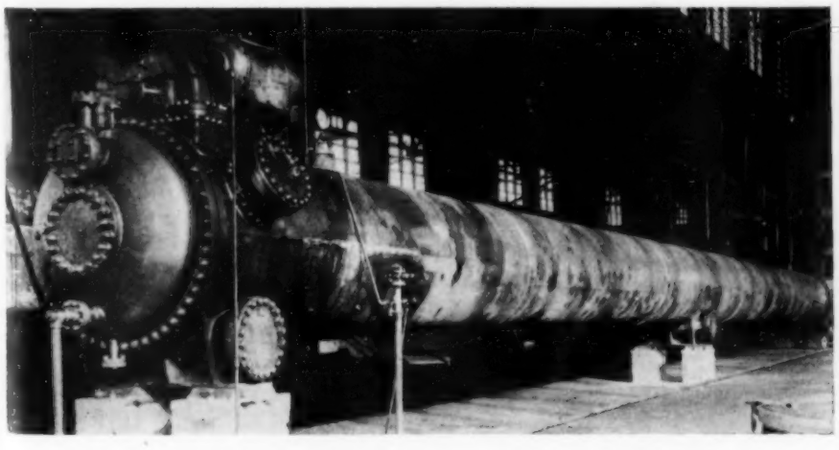
The cellulose material is thoroughly impregnated, preferably with an alkaline cooking solution, at a pressure of 5,000 lb. per sq.in. The pressure forms the cellulose into a continuous series of tight, dense plugs. These plugs are pressed by the reciprocating plunger of the press against the friction of the inside walls of the nozzle and the pressure within the digester until they reach the digester chamber. The impregnation of the raw material with an alkaline cooking liquor prior to digestion, it is claimed, gives an increased yield of stronger and more uniform pulp. Once inside the digester the plugs fall apart.

In case the charge does not have sufficient cooking solution to be properly digested, more of the liquor must be added to make up the required total quantity. The additional amount of liquor is passed through a flow meter and pumped through a heater which raises the temperature to that of the digester. It then enters the digester through a separate nozzle.

The digester is a long horizontal shell of small diameter. It rotates within a stationary outer shell. The steam between the two steel cylinders which is at a higher pressure than the steam in the digester or inner cylinder, is prevented from entering the digester and diluting the cooking liquor by a simple seal. The length of the digester determines the maximum cooking time for a given capacity of digester. The one shown in the accompanying illustration is 100 ft. in length.

When the cooking is complete the material leaves the exit end of the digester through the shut off valve and passes into the pulp press. The two pulp presses are similar in design and construction to the inlet presses. The pulp presses squeeze the spent liquor out of the pulp at the temperature of the digester thus preventing reprecipitation of coloring matter, and of ash containing substances in the fibers, giving a whiter pulp with a smaller amount of bleaching agent, avoiding rupturing of the cell walls by sudden release of pressure as when blowing, giving a stronger pulp, and extracting the spent cooking liquor from the pulp without dilution and without loss of heat, increasing the recovery of the chemicals and of heat. The spent liquor is drained off to the recovery system.

The plunger of the press forces the dried pulp into the repulper where it is thoroughly broken apart by the hammer and pins. Here hot water and dilute liquor are mixed with the pulp and the whole passes on to the second stage pulp press where the operation is similar to the first stage. On leaving the second press the pulp is conveyed to the stock chest and the process is completed. A more detailed account of this equipment appeared in *Paper Trade Journal*, Oct. 22, 1936.



The charging end of the de la Roza rotating digester. This particular digester is about 5 ft. in diameter and 100 ft. in length. In normal operation an impregnating and feeder press is connected at the left end of the tube, and a pulp press or series of pulp presses take the digested pulp from the right or discharge end of the tube. The tube must be mounted on trunions so that it may be rotated during digestion

Deflocculation and Controlled Separation Improve Domestic China Clay

By FRED E. SMITH

MANAGER, HARRIS CLAY CO.,
LUNDAY, N. C.

FOR ABOUT 50 years North Carolina china clays have been produced by means which, except for minor refinements, have remained substantially unchanged until the recent advent of the improved processes now being employed by two producers. The methods introduced by the Harris Clay Co., one of the oldest of the producers in the region, are those to be described here. Employing a continuous process embodying the deflocculation of the finely ground crude clay to permit carefully controlled separation of the clay from the non-clay substances, the new method has, for more than a year, consistently demonstrated its ability to produce a refined kaolin which gives evidence of being able to compete successfully with English china clay, even for the most exacting of uses.

In the past, domestic kaolin has never been accepted by the makers of vitrified ware as completely equivalent to the English and Czechoslovakian clays. Some of the domestic clays have shown excessive shrinkage, while others have fired to a poor color or have lacked plasticity. North Carolina clays are generally of good color, owing to their low iron content and practical freedom from titanium, but their plasticity has been less than desired. It has been estimated, however, that North Carolina's crude primary kaolins are of sufficient quantity to supply the entire whiteware industry in the United States for well over 100 years. Hence, the advent of processes capable of producing high grade china clays, relieved of their earlier disadvantages, is a development of noteworthy importance to the country.

For nearly 25 years the kaolin industry has operated in accordance with the suggestions made in 1913 by A. S. Watts of the U. S. Bureau of Mines. By 1916, however, Binns, Brown and Sproat had all presented papers before the American Ceramic Society in which consideration was given to the use of deflocculation in the refining process. During the next 20 years, several North Carolina refiners made apparently unsuccessful attempts to realize the benefits of this technique, and it was not until early in 1935 that the program of research which culminated in the improved Harris process was initiated. For a year and a half, the proposed process was investigated, first on a laboratory and then on a semi-commercial scale. In the summer of 1936 construction was started on a new plant at Lunday in the Spruce Pine district of North Carolina. This plant was completed and put into operation in November of that year and has since been in operation, turning out slightly more than its rated capacity of 24 tons of refined clay per 24-hour day.

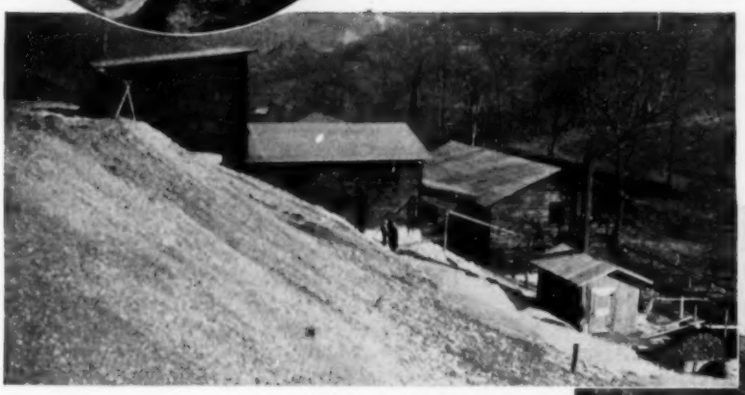
The new plant consists of four buildings, constructed largely of wood and concrete to avoid the possibility of iron contamination. What little iron there is is periodically coated with asphalt-base paint. The buildings are tightly sealed for year-around use and provided with unit heaters for maintaining a uniform temperature throughout the year. Concrete has been used for foundation walls, floors and for the hydroseparator, thickener and slip tanks. All pipe for water and clay slip is of copper. In addition to the processing buildings, a dryer building and a power plant have been provided. The plant is divided into two units, one on either side of the Toe River. Initial operations are conducted in a hillside type of plant situated on the same side of the river as the mines and one-quarter mile from the latter. This plant is connected with the second unit by a launder and pipe passing over the river on a light suspension bridge which also carries a footwalk.

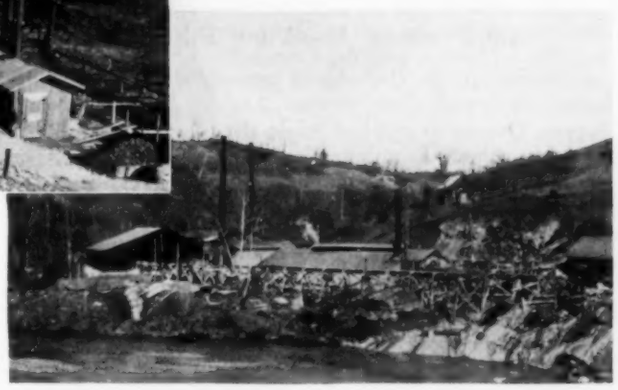
The plant produces both its power and its process steam requirements, using stoker-fired boilers supplying steam to a non-condensing engine. The latter is direct-connected to a 2,200 volt a.c. generator and the power is stepped down to 220 volts at points throughout the plant convenient to the motors. The exhaust steam is used for process heating so far as possible.

Mining is accomplished by the open pit method with both picking and loading by hand. The hydraulic mining originally employed, although considerably cheaper, was discontinued owing to the need for selective hand picking of the clay at the point of origin. Two trucks, carrying 4-ton loads, transport the clay to the plant. There it is delivered to a 150-ton bin from which a Jeffrey Traylor vibrating feeder discharges to an 8x3-ft. silex-lined Hardinge pebble mill operated by a 65-hp. induction motor. A man stationed in the storage bin further hand-picks the clay and keeps the feeder filled. An ammeter connected into the feeder electric circuit shows the load on the feeder and assists in securing a constant feed of clay to the mill.

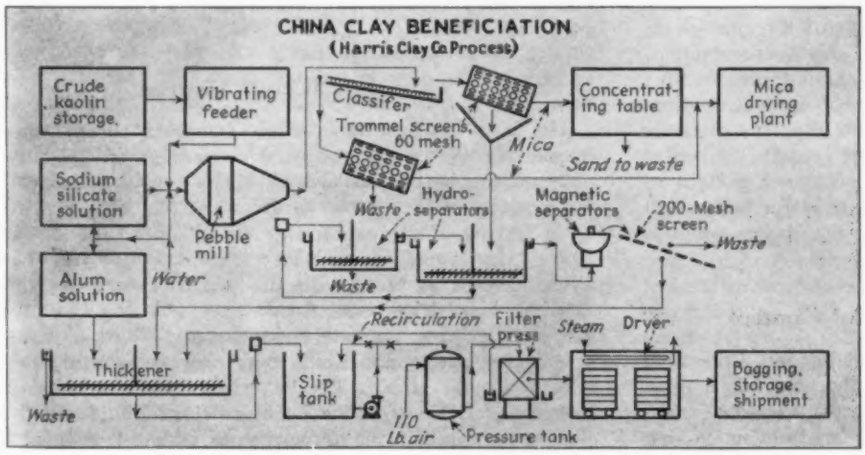
The process can best be followed in conjunction with the flowsheet on page 595. Water sufficient to bring the solids content of the pulp to about 50 per cent continuously flows through a meter and into the mill. Likewise sodium silicate solution is added continuously with the mill feed for the purpose of dispersing the clay particles. Concentrated sodium silicate solution is mixed

See also a paper by J. R. Grout, Jr., entitled, "A New Process North Carolina Kaolin Refinery," presented March 23, 1937, at the New York meeting of the American Ceramic Society; and an article appearing on page 341 of the July, 1937, issue of *Engineering and Mining Journal*.





Top: Part of the kaolin deposit. Above: Primary treatment plant of Harris Clay Co.'s present kaolin refinery; a 100-ton plant is under consideration. Right: Second unit of Harris Clay Co.'s refinery. Below: Flowsheet of new kaolin refining process showing principal pieces of equipment



60-mesh trommel screen for the separation of the clay from any mica which may be present. The oversize from this screen, containing the mica, goes to a concentrating table for separation of the mica from the accompanying sand. The sand is wasted while the mica is pumped in suspension to the mica plant. The undersize from the screen passes to a 24-ft. hydro-separator for the last stage of separation of the non-clay particles.

The hydroseparator is a Dorr concrete thickener, operated overloaded so as to serve the same function as an extremely fine screen. The overflow from this hydroseparator contains the desired clay particles, but since some of these particles are carried down with the denser non-clay particles and removed with the sludge, a second 14-ft. hydroseparator is provided for treating the underflow from the first. The overflow from the second hydroseparator contains this carry-over of particles which is returned to the first hydroseparator. The underflow, however, contains the non-clay particles and is pumped to waste.

The operations outlined above are those carried out in the first unit of the plant. The overflow from the main hydroseparator containing the clay originally present in the feed is transported by a launder to the second unit of the plant, where it is to be screened, concentrated, filtered and dried. Arriving in the second unit, the clay suspension is passed through two underfed Frantz Ferrofilters where the weakly magnetic minerals are removed. The magnetic separators discharge to two 200-mesh Tyler Hum-mer screens which, although intended for magnetic vibration of the screen surfaces, are operated stationary since their duty, with the new process, has been found to be very light. Alum solution for flocculating the clay is then added to the suspension as it flows to a 60-ft. Dorr concrete thickener sufficiently large to hold a week's supply of clay. The alum is put into

with the desired proportion of water in an agitated tank provided with a ¼-hp. propeller agitator. The specific gravity of the reagent flowing to the mill is checked hourly with a sensitive hydrometer. Reagent is fed into the water entering the mill by means of a piston type proportioning pump, controlled by the water meter.

After being ground the pulp discharges through a grate into a 4x20-ft. duplex Dorr classifier where the rake product, containing most of the quartz, feldspar and mica, discharges to waste. The intention, however, is later to size this sand over two 4x5-ft. trommel screens with 60-mesh openings, the undersize going to waste and the oversize being sent to the company's mica plant, there to be screened and dried in preparation for shipment. The overflow from the classifier passes through a

solution in a small tank, provided with a centrifugal pump for circulating the solution. The discharge line from the pump is controlled by a float valve in a feed tank supplying solution to an orifice box. Thus, solution is metered into the flow of suspended clay at a constant rate. However, this rate can be varied by the use of interchangeable orifices so as to maintain the desired pH as indicated by a recording pH meter.

Overflow from the thickener discharges to waste in the river. The underflow is pumped to a 50-ton slip storage tank in which it is recirculated to maintain uniformity, pending delivery to one of two pressure tanks feeding the filter presses. For this purpose a bronze self-priming centrifugal pump is provided, the discharge from which may be directed to one of the two pressure tanks or back to the slip tank.

Air Pressure Used for Filtration

Filtration of the clay slip is accomplished in two 63-frame Patterson filter presses having 26-in diameter leaves. One press is filled while the other is being discharged. About 30 minutes is required for filling. The feed to the filters is accomplished by air pressure at a maximum of 110 lb. Slip is pumped to one of the two cylindrical pressure feed tanks and air pressure applied to its surface by a compressor equipped with a constant-pressure unloader. For proper pressing a definite time-pressure cycle is followed. The presses are supplied with double cloths and rubber gaskets. Weekly washing and airing of the cloths is practiced. To avoid any possible loss of clay, the filtrate is returned to the 60-ft. thickener.

In the presses, the moisture content of the cake is reduced to about 32 per cent. The cakes are stripped, placed in carts and transported to the dryer building where they are dried with exhaust steam in heating pipes at a temperature of 78 deg. F. Thus the free moisture content is reduced to 2 to 4 per cent. Care is taken to hold the temperature under 85 deg. C. since certain of the kaolin minerals are believed to lose water of crystallization at that point. After drying, the clay is weighed into sacks and stored, prior to shipment.

Process Requires Careful Control

The foregoing outline of the process and equipment has only occasionally mentioned the careful control methods which must be followed in order to assure satisfactory operation of the process. It has been noted that the crude clay itself is carefully hand-picked. To assure uniform grinding conditions, periodic checks of the pebble content of the mill are made to serve as a guide in adding weighed amounts of pebbles at definite intervals. Water added in the mill, as well as all other water used in the process, is metered twice. The total flow is recorded by an orifice meter while four displacement type meters record the flow at various points in the process. Sediment separators in the water line are provided to catch any sediment not removed in the settling chambers at the plant reservoir. Steam is injected under thermostatic control into the main water line through a fine mesh screen, maintaining an even water temperature summer and winter. To check this constancy, a recording thermometer charts the temperature of the clay flowing from the classifier.

Control of the addition of sodium silicate for flocculation is secured through several settling tests run each hour. A check on these tests is made by a recording pH meter which is sensitive to variations in the clay feed, the water and, to a slight degree, the reagent. Density of the classifier overflow is taken and recorded each hour.

Periodic tests of the underflow from the hydroseparators are made in order to insure an operating balance. At the point where the alum solution is added to the clay suspension, control is obtained through the use of a second recording pH meter which is checked at intervals by colorimetric pH equipment as well as by a portable antimony electrode pH meter. Furthermore, each hour settling tests are made in a graduate at this point. Leaving the thickener, the thickened slip is tested hourly for specific gravity, being thinned with water if it is too thick, or being returned to the thickener if too thin. This control is necessary in securing satisfactory pressing. As a check, the density of the slip leaving the slip tank is also determined at intervals. The temperature of the slip in the slip tank is maintained by a thermostatically controlled steam coil and the temperature indicated by a dial thermometer.

In drying, control is secured through the use of a temperature recorder and daily moisture tests of the clay. Further improvements in the drying equipment are planned. The final product of the dryer is tested daily for dry shrinkage and dry modulus of rupture, for residue on a 325-mesh screen, for viscosity and for drying behavior. Regular tests are also made on the absorption, color and burning shrinkage of the clay as fired in an electric kiln controlled by a recording pyrometer on a time-temperature schedule between cones 9 and 12.

Thorough Blend Assured

The large size of some of the equipment used makes it possible to average out any variations in the raw material supplied to the process. The considerable holding capacity of the hydroseparators and the thickener, the latter having a storage capacity of 150 tons, and of the 50-ton slip tank, insure thorough blending. As has already been noted the slip in this last tank is continuously mixed by recirculation except during the time that slip is being pumped to one of the filtering tanks.

Working properties of the new clay are considerably improved over the old. The "liveriness" characteristic of North Carolina clays has been entirely eliminated, the clay wedges well, gives a smooth cut with a 1 mm. wire and peels readily from a paster slab.

In the mine now in use, there is a tested area estimated to contain a clay tonnage sufficient to operate the new refinery for seven years at maximum capacity. Within economic hauling range of the refinery are other mines leased or owned, which have been prospected sufficiently to insure a supply of raw material similar in character for an additional period of 25 years. These estimates are based on a recovery of 10 per cent which is seldom exceeded under present-day practice, even at old process plants. Although sufficient data are not available for determining the yield at the new refinery exactly, tests made at another refinery and confirmed by pilot plant tests of several weeks' duration, have shown that the new process recovers as much as the old, even though re-refining of the old process clay invariably eliminates a considerable percentage of residue.

Germany Makes Improvements In Electrolytic Processes

MANY improvements have been made in the design of electrolytic cells for the production of chlorine and caustic soda. In Europe horizontal cells (Siemens-Billiter) are chiefly used. Vertical cells take up less space and the cathodes are more accessible, while the horizontal cells have the advantage of longer life since a smaller surface is exposed to the attack of hypochlorite anolytes. With approximately the same degree of current utilization (94-96 per cent) and voltage (3.3-5.5 v.) the horizontal cells yield a stronger alkali solution (3-3.5 n.) than the vertical cells (2-2.5 n.).

The recently developed horizontal type Siemens-Pestalozza cell overcomes the drawback of the Billiter cell which is affected by current interruptions which often damage the diaphragms. The anode arrangement is similar to that of the Billiter cell, but the cathodes include iron rods contained in asbestos hose which permit the electrolyte but not the gas to pass through. The hydrogen is led off through hose over a side chamber, while the cathodically formed alkali is removed continuously, partly through hose and partly by way of the bottom tank. Since the pores of the asbestos hose do not become clogged like the Billiter diaphragm, the new cell has the additional advantage of permitting the use of an impure sodium chloride solution.

Since the formation of hypochlorite and chlorate reduces the effective utilization of electric current, all circulation must be avoided which tends to mix the caustic soda with the chlorine-containing anolyte. After gravity separation there is more danger of a re-mixture with the vertical than with the horizontal system, in which the process can be assisted by special construction measures such as providing a hollow space below the cathodes, inserting perforated sheets to insure a finer division of chlorine gas bubbles, etc.

So far it has not been possible, however, to obtain a chlorine-free caustic which is required by the rayon industry. In order to overcome this difficulty, cells with mercury cathodes are coming into use again in Germany even though they have some disadvantages. They require a higher voltage (approx. 5 v.) and are not as safe as the diaphragm cells because of the danger of a detonating gas being formed through a mixture of hydrogen and chlorine. Through heating the amalgamation decomposer it is now possible, however, to speed decomposition and to obtain a more concentrated caustic solution of 50 to 85 per cent.

No radical changes have been made in the electrolytic production of hypochlorites and chlorates. Impregnated graphite anodes are largely replacing platinum and magnetic anodes, although in perchlorate production it has not yet been possible to find a substitute for platinum.

The high degree of purity of the hydrogen obtained industrially in the above processes indicates the possibilities of electrolytic hydrogen production. Numerous processes have been developed for industrial hydrogen production from caustic potash with oxygen as a by-product. They practically all include a diaphragm subdividing the cells to separate the hydrogen and oxygen, and both unipolar and bipolar electrode systems are in use. Attempts are being made to cut down voltage, which is still twice as high as theoretically necessary (1.23 v.).

The loss of voltage caused by gas bubbles can be reduced somewhat by attaching perforated plates to the electrodes. Forced to go through the holes of these plates the gas bubbles are not such an interference and leave the actual current freer. The resulting increased circulation helps to equalize differences in concentration, and this measure can be assisted by raising the temperature of the bath to 80 deg. C., which has the disadvantage, however, that the 30 per cent caustic potash solution attacks the cell materials. To some extent it has been possible to reduce overvoltage through special shaping of the cathodes and anodes.

There is a difference of opinion among chemical engineers as to the most effective size of electrolytic units. Some favor large cell units producing as high as 500 cbm. and more of H_2 per hr., while others prefer to continue using smaller units where they feel the loss in production to the whole plant will not be as great in case of a breakdown of one unit.

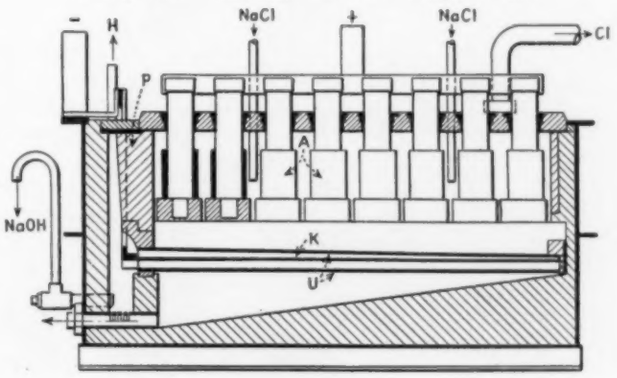
High pressure electrolysis is still in the experimental stage. A notable advantage of high pressure electrolysis (for example at 150 atmospheres) is to be found in the reduction of the volume of gas bubbles and thus of ohm resistance, with an additional saving of energy otherwise required later to compress the gas. These two factors account for a saving of about 15 per cent in electric current consumption.

Another industrially important application of electrolysis is in the making of persulphates for the manufacture of hydrogen peroxide. The electrolytic production of persulphuric acid, which can also be converted into H_2O_2, has largely been supplanted by the use of ammonium persulphate which can be obtained more economically than the free acid.

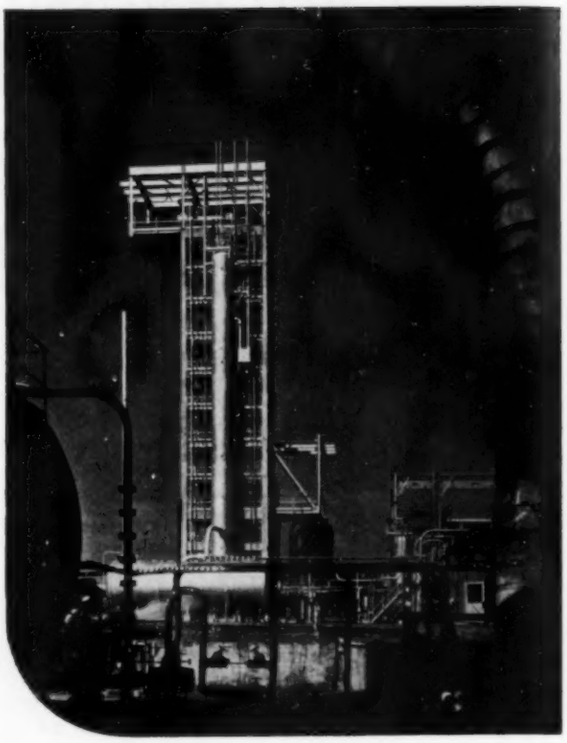
For persulphate electrolysis using platinum anodes it is possible to secure 90 per cent current utilization as against only 70 per cent for persulphuric acid. Hydrogen peroxide may then be obtained through vacuum distillation of the persulphate, the residual sulphate being returned for further electrolysis. The energy required to produce 1 kg. H_2O_2 (computed water-free) is now 12-15 kw.-hr.

Less important electrolytic processes being developed industrially in Germany include oxidation products as ferricyanides, permanganates, chromic acid, manganese dioxide, etc.

The horizontal Siemens-Pestalozza cell overcomes the drawback of the Billiter cell.



Condensed from an article by Dr. Hellmut Fischer of Berlin appearing in *Die Chemische Fabrik*, July 7, 1937.



Column for separation of propane and butane

By E. H. McARDLE
STANDARD OIL DEVELOPMENT CO.
NEW YORK, N. Y.

"COAL-TAR" SOLVENTS From PETROLEUM

Advances in synthetic resins and protective coatings as related to the development of high solvency naphthas

TODAY SYNTHETIC RESINS are almost as commonplace as glass or wood or metal. "Bakelite" has rooted itself in the language, along with "soap" and "sugar". When we see a new material which is cheap, lightweight and translucent, or smartly colorful, we appraise it knowingly and are likely to dismiss it as merely one more "synthetic". Such a close familiarity, developed in the course of barely two decades, is the natural result of frequent sight and handling of the new products themselves—in the form of consumers' goods.

Quite the reverse is true in the case of the related materials which enter lacquers and enamels. Few laymen are yet aware that synthetic resins have come to be regarded as the prime ingredient of durable protective coatings—or even, indeed, that synthetics are used in paint. Still fewer realize that in a rapidly increasing variety of coatings the resin alone can successfully serve as the entire non-volatile component of the vehicle. Thus to some may come as a surprise the estimate of one reliable authority that some 45 per cent of the total current domestic resin production finds its way into compositions for the coating of surfaces.

It is difficult even roughly to estimate the partition between molding compounds and coating materials. In the manufacture of such coatings as refrigerator whites and automotive enamels the resin as such may never be seen; it usually is cut with solvent or modified with oil while still a hot liquid, and then routed to a nearby point in the same plant for further blending and pigmentation.

But even with the great impetus which industrial designers and interior decorators have given to the popularity of molded resin products during the past eighteen months, the superiority of the new industrial enamels derived from synthetics over conventional varnish and lacquer enamels has provided a still greater stimulus for production. In spite of all the replacement of wood and metal by molded plastics which require no finish, there yet remains a vast acreage of sheet steel to paint. This brings us to the interesting development of low cost solvents for synthetics.

Steel vs. Coal Tar

As steel mill operations approach capacity, more and more coke ovens are pressed into service, and more coal tar results. Balancing on the one hand the fluctuations in steel scrap and the international rearmament situation as affecting the fraction of pig iron in steel, and on the other the parallel increase in demand for chemical raw materials and motor benzol, it might appear that the increased supplies of toluol, xylol, and solvent naphtha—formerly the cheapest solvents capable of cutting durable synthetics—would tend to stabilize the market for these staple commodities. But the paint requirements for the steel sheets produced—as automobile bodies, refrigerators, and structures—puts solvent manufacturers to "scraping their tank bottoms," and prices range accordingly (Fig. 1).

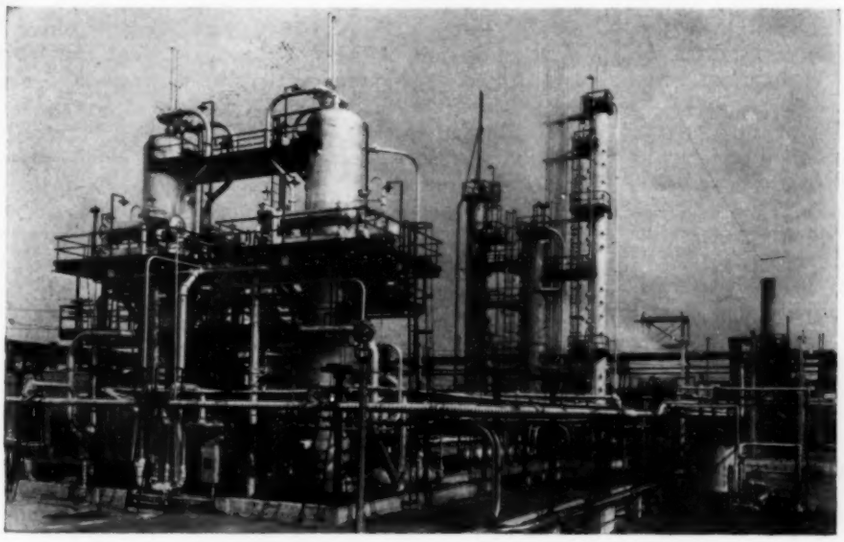
Whether the paint manufacturer purchases his synthetics or produces them himself, he is faced with the cost of getting them into solution. In the conventional varnish the problem is fairly simple; cooking the resin with oil

enables him to get along with a paraffinic petroleum thinner—itself a non-solvent for the original resin. On the other hand, for lacquer compositions and resin enamels he must cut his resin directly with a solvent. Here his choice, up to the past few years, has lain between a straight coal-tar and a petroleum thinner whose solvency has been augmented by blending with a powerful oxygenated solvent, such as an alcohol, acetate, or alcohol-ether. The latter method, although feasible for reducing the viscosity of a material already in solution, has not been found to be entirely satisfactory. A large proportion of resins are cut hot; and an aromatic hydrocarbon solvent is much to be preferred from the standpoint of the composition of the solution itself, as well as on account of operating difficulties arising from the use of oxygenated solvents at elevated temperatures.

Aromatic and Naphthenic Naphthas

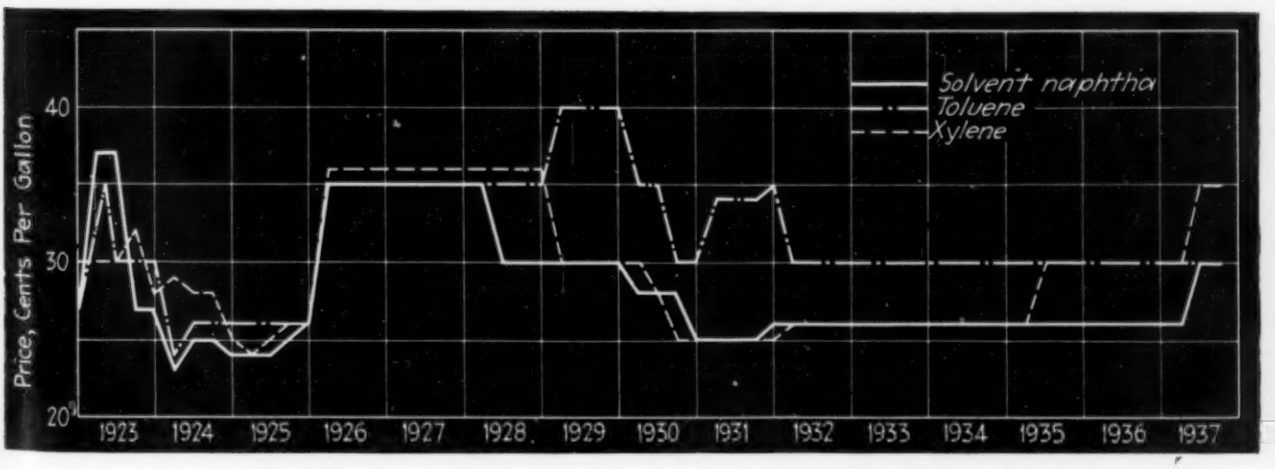
From the start, the development of synthetic resins has been aided by solvents and thinners from petroleum. Replacement of rosin by ester gum enabled paint makers to produce spar coatings uniformly and cheaply, and thus broadened the market for oleo-resinous varnishes. Increased costs of the ester over rosin, and the accompanying tung oil over the previously used linseed, were balanced by the far lower cost of petroleum thinner as compared with turpentine. As the modified phenolics came into use during the middle and late 'twenties, bringing with them the four- and two-hour enamels, a demand for greater solvency was made upon the thinner, and refiners looked to naphthas topped from naphthenic crudes. Finally, the arrival of hot-cut synthetics required true solvents—rather than thinners—and required them quickly, cheaply, and in quantity.

Oil for the lamps of China was originally shipped from the Atlantic seaboard, and it continued to flow from this source long after the Pacific Coast refineries were well established. The early kerosene fractions from California crudes were sufficiently naphthenic to make the conventional kerosene lamp wick smoke. Thus California refiners were among the first in this country to



Left:—The very light petroleum fractions are removed in this gas absorption unit

Fig. 1 (below)—Price trends in coal-tar solvents during past fifteen years



install solvent-extraction plants for the removal of aromatics and naphthenes from burning-oil distillates. As originally separated, these extracts had little more than fuel blending value.

If the resin solvency of a pure aromatic hydrocarbon be taken as 100, then the corresponding naphthene has a solvency ranging from 48 to 55, the straight-chain paraffin approximately 25, and the highly branched paraffin from 30 to 35. For cutting the most durable types of synthetic coating resins, at least 75 per cent the solvency of the correspondingly boiling aromatic hydrocarbon is desirable if the solution is to have a workable viscosity and at the same time an economically high non-volatile content. In other words, to compete with coal tar solvents, petroleum refiners were forced to turn to their most aromatic naphthas and carefully refine out any objectionable components which might adversely affect the constituents of a coating. This last requirement eliminated naphthas derived from cracked sources; difficulty in removing the last traces of unsaturates and cracked sulphur compounds has given paint makers a profound distaste for such troublesome raw materials.

Thus it came about that during the late 'twenties and early 'thirties several California refiners who were already equipped to solvent-refine naphthas were in a position to furnish highly refined cuts in the toluene, xylene, and higher boiling ranges, with solvencies varying from 60 per cent (in the toluene range) to 80 per cent (in the solvent naphtha range) of those of coal-tar fractions. Selected crudes were required, and the solvencies of the products were limited by the inclusion of a large proportion of naphthenes in the solvent extracts. But the source of supply was plentiful, the equipment already there, and hence a level price resulted. For general "high solvency" work the naphthas could replace mixtures of coal tar solvents and paraffinic thinners; and thus, priced as they were at roughly half the cost of coal-tar solvents, they provided a comparative saving of several cents per gallon. However, their immediate commercial application was delayed by the fact that the preponderance of synthetic resin development was in the East and Middle West.

Hydrogenated Naphthas

Meanwhile, in the East, hydrogenation as a source of aromatic naphthas proved more flexible than extraction. A virgin petroleum naphtha has a definite and limited content of true aromatics, invariably mixed with a percentage of naphthenes, together with paraffins; and solvent extraction is considerably less effective in separating aromatics from the other two, or aromatics and naphthenes together from paraffins, in the lower boiling ranges than in the higher, less marketable, fractions. Further, the manufacturers and consumers of resins were eager for a stable supply of hydrocarbon solvents which were fully equal to coal tar cuts in solvency, and available at a stable price.

As developed during the early 1930's, hydrogenated naphthas, numbered from one to four, approached coal tar solvency more closely than any petroleum naphthas yet produced.

The No. 1 fraction, a toluene substitute, had two-thirds the solvency of industrial pure toluene; but the No. 4 cut actually surpassed the corresponding coal-tar fraction (boiling from 420 to 520 deg. F.) in solvency for resins and oleo-resinous compositions. Fraction No. 3 consisted chiefly of substituted aromatics—all excellent resin solvents. After removal of naphthalene, which affected the crystal point for cold weather handling, it was found that the solvency was fully equal to the corresponding 365 to 420 deg. F. coal-tar cut. Fraction No. 3 proved useful where evaporation rates slow enough for the proper leveling and drying of low temperature baking enamels were required.

Fraction No. 2 consisted largely of a mixture of xylenes and C_9 and C_{10} aromatics. Its solvency was approximately 90 per cent that of industrial xylene, or some 95 per cent that of commercial high-flash naphtha, and thus it came to the fore as the most desirable of the series for general resin work.

Solvency Characteristics

By early 1934 hydrogenated naphthas had taken their place in industry, demand quickly exceeded supply, and the hydro solvents continued to meet increasingly stringent requirements.

The hydrogenation process (as described by Sweeney and Tilton, *Ind. & Eng. Chem.*, June 1934) is one which converts higher boiling petroleum fractions by high temperature catalytic hydrogenation to lower boiling aromatic type distillates. Since that time it has been found possible, through advances in the knowledge of petroleum constitution and in the technique of solvent extraction, to produce aromatic type solvents of the required boiling range and improved solvency. Solvent plant facilities were made available and production started in 1936 on three new grades. Characteristics of two of these solvents are shown in Table I. It can be seen that the insistent demand on the part of paint makers for ever greater solvency has been met, and the present aromatic solvent naphthas, numbers 1 and 2, rank very close to coal tar solvents.

The No. 2 fraction possesses some 93 per cent the solvency of industrially pure (10 deg. C. boiling range) xylene, or over 100 per cent that of coal-tar high-flash naphtha. The No. 1 ranges from 75 per cent to 85 per cent the solvency of 2 deg. C. toluene, depending upon the purpose for which the material is used. From the following fractional solvency table the composition of the fractions and their behavior in coating formulas may be accurately gaged.

Table 1:—Fractional Solvency Characteristics—Specimen Inspections

Fraction No. 1	API gravity	Per cent aromatics	Kauri value	Mixed Aniline pt. °C.	Dil. 10%	Rat. cot.	BuAc final
Whole solvent	40.9	73	72.5	26.7		2.25	
First third evaporated	43.9	65	68.4	30.3		2.10	
Second " "	40.7	73	73.5	26.4		2.25	
Last " "	38.1	80	76.3	23.0		2.35	
Last sixth "	37.3	81	76.5	22.1		2.50	
Industrial pure toluene (2° C.)	31.6	100	93.5	10.0		2.75	

Fraction No. 2	Per cent aromatics	Kauri value	Mixed Aniline pt. °C.	Alkyd resin Solvency (c.c.)*
Whole solvent	92	78.5	17.4	46.4
First third evaporated	90	79.7	17.2	46.4
Second " "	92	79.5	16.9	47.2
Last "	93	77.0	17.6	45.9
Last sixth evaporated	92	75.5	18.0	45.5
Industrial pure xylene (10° C.)	100	84.0	13.9	51.8
I.P. high-flash C.T. Naphtha	91	80.0	20.2	44.4

* c.c. mineral spirits of 60° C. aniline point (e.g., 8 volumes kerosene mixed with 2½ of varnish thinner) tolerated by a solution of 10 grams Amberol No. 801 in 40 grams solvent.

Solvency Specification Tests for High-Aromatic Solvent Naphthas

The only safe method by which a paint manufacturer can determine the worth of a new raw material in his various formulas is to make up test batches and submit them to the rigors of actual use. For solvents, however, it is helpful for producer and user alike to evaluate preliminarily by solvency tests. Unfortunately, few such tests have been standardized to an extent where they are widely acceptable to both parties concerned, but the following six methods have demonstrated themselves as being easily reproducible by various operators, and capable of being run in most paint and solvent laboratories.

Kauri-Butanol Test

The Philadelphia Paint & Varnish Production Club has developed a reliable method of standardizing solutions of No. 1 kauri resin in normal butyl alcohol by using a "primary reference mineral spirit" whose kauri-butanol value is arbitrarily set at 40 (*Paint, Oil and Chemical Review*, Nov. 26, 1936). Solutions containing approximately 20 per cent by weight of unrun kauri resin are brought to standard strength by changing resin concentration until 20 grams of solution become just cloudy when titrated at 25 deg. C. with 40 c.c. of the reference spirit.

Standardization at the low value of 40 proves adequate in testing the lower solvency naphthas, such as V. M. & P. and varnish spirits, but serious inaccuracies may arise when evaluating highly aromatic petroleum fractions whose solvencies approach those of coal-tar solvents. Thus a second standard point, in the upper range of kauri-butanol values, becomes essential to the correct testing of high solvency naphthas. Such a point is conveniently taken as the kauri-butanol value of C. P. benzene, and arbitrarily called 100 (Baldeschwieler, Troeller & Morgan, *Industrial & Engineering Chemistry*, p. 374: Nov. 15, 1935). In the accompanying tables and graphs, the kauri values are presented on the basis of the benezene value of the kauri solution used.

Currently, the Philadelphia Club is showing that industrially pure toluene, the 2 deg. C. lacquer grade, is preferable to benzene, since the former's kauri value is more precisely determined by a large variety of operators. Importance of correct interpretation of kauri-butanol values has been exemplified in the recent past by differences of as much as eighteen points in published "kauris" of high solvency naphthas. These have occurred mainly through lack of employment of reference mineral spirits and subsequent alignment against benzene or toluene.

Mixed Aniline Point

Straight aniline points of aromatic naphthas fall at temperatures too low for convenient determination. Hence a method recently developed in the du Pont laboratories at Philadelphia, wherein 5 c.c. of a mineral spirit (regardless of boiling range) of 60 deg. C. aniline point are mixed with 5 c.c. of the solvent under test and 10 c.c. of anhydrous aniline, is rapidly gaining favor. Mixed aniline points vary from 10 deg. C. (for toluene) up to 40 deg. C. (for intermediate solvency naphthenic-base extracts), and are thus easily measured by warming or cooling the test tube under a tap. Results may be checked within 0.1 deg. C. between two operators if precautions are taken to insure dryness of aniline—two burette drops of water in 10 c.c. aniline may raise a mixed aniline point as much as 3.0 deg. C. Further, aniline point is the only solvency test commonly employed where no temperature control is required.

Fig. 2 illustrates the relationship between mixed aniline points and kauri-butanol values. Unidentified points (X's)

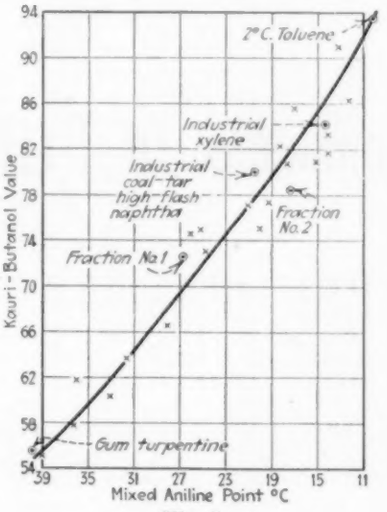


Fig. 2

were taken for experimental naphthas in the solvency range above gum turpentine.

Synthetic Resin Solvency

Effectiveness of aromatic naphthas as resin solvents may be measured by (1) viscosity of the solutions, or (2) tolerance of the solutions for low solvency mineral spirits.

Viscosity is a test which each user of aromatic solvents ordinarily prefers to run himself, on his own particular variety of synthetic, and in concentrations corresponding to those used in his formulas. Saybolt, Ostwald, or Ubbelohde pipettes, operating at 100 deg. F. or 25 deg. C., may be conveniently employed. However, viscosity is not only a function of solvency, but also of the boiling range—and therefore viscosity—of the solvent itself. Thus the "resin tolerance", or "resin dilution ratio", of a resin solution for low solvency mineral spirits provides a clearer and more inclusive indication of solvency.

A clean-scraped piece of resin from a recent shipment is freshly powdered and 10 grams are dissolved by shaking cold in a tightly stoppered flask with 40 grams of solvent. The flask is placed in a water bath maintained at 25 deg. C., and titrated to cloud point—illegibility of typewriter lettering as viewed through the solution—with mineral spirits of 60 deg. C. aniline point.

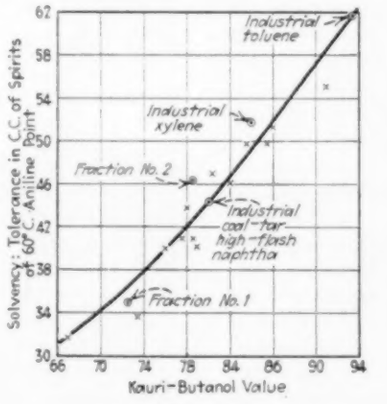


Fig. 3

Fig. 3 shows the relation between kauri-butanol value and "resin tolerance" for a number of solvents in the upper solvency range. The sample of resin used for this work had been standing in a closed can for four months; a week-old sample of the same material gave values approximately 5 per cent higher.

Nitrocellulose Dilution Ratio

For thinners approaching toluene and xylene in solvency, a reasonably precise method for running dilution ratios has been adapted from "Method II", described on p. 1088 of "Physical and Chemical Examination of Paints, Varnishes, Lacquers, and Colors", 1937 Ed., by H. A. Gardner.

Ten grams of a solution containing three parts by weight of bone-dry ½-sec. nitrocellulose in seven parts by weight of normal butyl acetate are weighed into a 125 c.c. glass-stoppered Erlenmeyer flask. An additional gram (1.2 c.c.) of acetate is added, to make 8 grams total solvent, together with 15 c.c. of thinner under test. Complete solution is effected by shaking. Successive 1-cc. portions of thinner are added and thoroughly shaken until small globules of separated cotton just fail to re-dissolve.

Of a thinner with a dilution ratio of 2.50, 20 grams will be required, bringing the total weight to 31 grams, or a "cotton final" of 9.7 per cent. For more powerful thinners, i.e., toluene, the extra gram of butyl acetate is omitted; for less powerful ones, 2 or 3 extra grams are added before titration — the purpose being to strike closely to 10 per cent "cotton final," approximately the concentration in many commercial nitrocellulose finishes.

Preparation of a stock solution in normal butyl acetate is preferable to the repeated handling of bone-dry cotton itself. No measurable change has been observed in the solution during six months storage in a closed container kept in the dark.

Aromatic Content

An aromatic naphtha of a degree of purity suitable for coating materials must contain less than ½ per cent of unsaturates. Hence the fraction absorbed by the Kattwinkel reagent (30 grams of P_2O_5 dissolved in 100 c.c. of 100 per cent H_2SO_4) provides a measure of aromaticity.

The test is rapid and precise. In a 10 c.c. graduated Babcock bottle a precooled (in ice) mixture of 10 c.c. of solvent and 20 c.c. reagent is shaken mechanically for 20 min. in a water bath kept below 25 deg. C. Bottle and contents are re-cooled in ice, filled to capacity with more reagent, centrifuged 10 min. at 1000 r.p.m., and the per cent absorption read.

For high solvency naphthas of naphthenic base origin, unduly high Kattwinkel values are obtained, due to partial absorption of naphthenes by the reagent. Solvents obtained from aromatic-base stocks, however, which are low in naphthenes, show good concordance between Kattwinkel absorption and true aromaticity as determined by nitration with non-fuming mixed acids.

Surface Tension

Surface tension at 25 deg. C. against air, as found by the De Nouy tensiometer, conforms to the kauri-butanol value of a solvent as a more or less linear function *in any given boiling range*. Value of the test for the lower boiling solvents lies in the wide acceptance of the apparatus itself, the fact that it may be set up permanently in a small space and requires no material other than the solvent under test, and the ease of checking results. The following table relates boiling points, kauri-butanol values, and De Nouy surface tensions against air at 25 deg. C.:

	B.P. °C.	Kauri value	Surface tension Dynes/cm
Benzene	79.6	100	30.21
Cyclohexane	80.6	54.3	26.09
n-Hexane	69.0	26.5	18.06
Toluene	110.8	93.5	29.52
Solvent fraction No. 1	95/135	72.5	26.53
Methylcyclohexane	101.0	45.0	24.91
n-Heptane	99.0	26.4	21.45
10° C Xylene	135/145	84.0	29.53
Solvent fraction No. 2	135/177	78.5	29.25
V. M. & P. Naphtha	100/170	33.4	24.14
n-Octane	125.0	24.5	22.75

Tomorrow's Developments in Utilization of Wood

EDITORIAL STAFF

ONE OF THE IMPROVEMENTS in pulp for rayon purposes in the near future will probably be the production of a chemical cellulose of high alpha cellulose content, and by this is meant about 96 per cent. R. S. Hatch, director of research for the Weyerhaeuser Timber Co., Longview, Wash., told the members of the Canadian Chemical Association at their recent meeting. Many laboratories are engaged in this work at the present time and a great improvement in the chemical purity of cellulose for rayon pulps is sure to follow.

Sulphate Pulp for Rayon

There are certain species of wood, particularly those with high resin content such as the southern pines, douglas fir, jack pine, etc. which do not lend themselves readily to the sulphite pulping process and are generally manufactured by the sulphate process. This process yields a very strong fiber. Rapid advances are being made in the knowledge of the sulphate process as well as in the bleaching of this pulp, which will eventually make this type of pulp a strong competitor of sulphite pulp for rayon manufacture, according to Hatch.

The previous remarks refer to the use of wood pulp for the viscose process only. The chardonnet process has been entirely discontinued. The cupra-ammonium process is small compared with the viscose process and is not increasing in volume. On the other hand the acetate process is increasing rapidly. So far, both the cupra-ammonium and the acetate processes have used cotton as a raw material almost exclusively. It is reported that some acetate fiber is being produced in England from wood pulp, but probably none is being produced in this country.

One of the main difficulties in the use of wood pulp for this process is the physical form in which it is marketed. Pulp for both paper making and for the viscose process is produced in the form of heavy sheets which are well adapted to both uses. Machinery in the viscose process has been developed for the precise and efficient handling of pulp in sheets and the viscose producers' only requirement is that these sheets be uniform in structure and thickness so that they will absorb the mercerizing solution evenly and uniformly. The acetate process is, of course, quite a different matter. Cotton cellulose is readily acetylated because of its open fluffy nature. Wood pulp, to be, as successfully acetylated must also be produced in a form that can readily be penetrated and surrounded by the acetylating solution. It must also be of high alpha content because the chemicals used for acetylating are expensive and are uselessly consumed in reaction with the hemi-celluloses. A considerable amount of work is now being done with the object of producing from wood a pulp of high alpha cellulose content and of a physical form which will acetylate readily.

The cellulose plastics industry is much older than the synthetic fiber industry. Cotton has always been the universal raw material for the production of cellulose nitrate. This material, however, has many disadvantages because of its ready flammability. With the discovery and the perfecting of processes for the manufacture of cellulose acetate, a new field for the use of cellulose was opened up. According to the U. S. Bureau of Census figures, the production of cellulose nitrate in the United States in 1933 was 11,916,000 lb. and in 1936 it was 16,932,850 lb., showing an increase of 42 per cent. The production of cellulose acetate in 1933 was 2,482,111 lb. and it had risen in 1936 to 13,036,497 lb. An increase in the same period of 405 per cent. These figures are food for serious consideration and point very definitely to the desirability of producing a chemical pulp which will be entirely satisfactory for acetylation. This is by no means a simple task but when we reflect upon the advances which have been made in the production of chemical cellulose from wood for the rayon industry and the tremendous market which has been built up, we need have little fear of the ultimate successful production of wood pulp for acetylation.

Pulp for Acetylation

Within the past few years, cellulose ethers have begun to appear on the market. These products possess unusually interesting commercial possibilities and we may expect a rapid commercial development in this field. Both cotton and wood pulp have been used for making these products. Here again the question of chemical purity will probably influence the manufacturers' choice of raw material and any development which will lead to the production of a better cellulose for acetylation should be an equally valuable aid in producing pulp for the manufacture of cellulose ethers.

Three rather interesting possibilities in connection with the disposal of sulphite waste liquor arise: (1) when lignin is first removed from sulphite waste liquor, the methods of disposal are greatly simplified and similar to

those used in the disposal of sugar wastes; (2) when septic tank of contact bed sewage methods are used the sugars can be completely gasified and the resultant lignin containing solution is stabilized and its pollution effect greatly reduced, and (3) when lignin is present or not, with selected organisms and in concentrations such as obtain after the washing of the pulp, the sugars may be quantitatively converted into butyric and acetic acids in a two-day period. These possibilities were mentioned by Dr. H. K. Benson, University of Washington, Seattle.

Use of sulphite waste liquor in stabilizing the soil that constitutes our secondary roads holds a good deal of promise and warrants a greater expenditure of research than has been given to it up to the present, according to Dr. Benson. In the state of Washington waste liquor has been commercially used for road soil stabilization. In the eastern part of the state the entire output of waste liquor is applied in unaltered form for maintaining the dirt roads in that section. Over 2,000 miles of highway and streets are treated with it in the vicinity of Spokane. It is considered superior to oil for this purpose. Applied after rain it follows the moisture down into the soil then as the road dries, a hard dust-free and smooth crust or surface forms. Two or three applications are made in each season.

In western Washington the Ranier Pulp & Paper Co. has operated for some time a plant with a capacity of 1,000 barrels per day for the evaporation by waste heat of its waste liquor. This product contains from 44 to 48 per cent solids. It is known as "Raylik B" and shipments have been made to New Jersey and other states for the treatment of dirt roads.

A Fertilizer Material

The work of Guy Howard and his associates in Wisconsin has resulted in the commercial operation of a plant to separate the calcium sulphite and reuse it in the acid making towers and to utilize the organic materials for fuel or lignin derivatives. The ammoniation of waste liquor by Phillips and his associates of the U. S. Bureau of Chemistry and Soils calls attention to its possible use as a fertilizer material and the increasing interest in the substitution of ammonia in place of calcium in the cooking liquors of the sulphite pulp process points to interesting developments in the field.

When the field of lignin chemistry is more fully explored and becomes better known it is reasonable to believe that the disposal of sulphite waste liquor will no longer be a problem but rather a lucrative practice in the industry.

The use of wood as a source of producer-gas for power and heat has been intensively studied in Europe, Prof. Edwin C. Jahn of the University of Idaho told the group of chemists and chemical engineers. A number of sawmills and wood-working plants have successfully developed producer-gas plants which utilize the waste wood for power. Several automobile manufacturers are now making commercial vehicles of all types equipped to operate on wood gas. Figures from test runs are quoted which indicate that in Europe it is much more economical to operate on wood gas than on gasoline. Twenty-five pounds of wood are reported equivalent to one gallon of gasoline.

Briquette making is essentially a mechanical process although certain chemical reactions probably do occur. The invention of the screw sugar type of machine by Potlatch Forests Inc. of Lewiston, Idaho, with a capacity of 10 to 11 tons per 24 hr., has been one of the few new and novel methods of waste utilization recently developed. Last year 40,000 tons of briquette were produced in Idaho alone. At present only refuse from planing mills and box factories is utilized. A hogged fuel drier utilizing stack gases has been developed so that green sawmill waste may be used.

Sugar From Wastes

Research over a period of years by two investigators and their associates have led to the recent development of two industrial wood hydrolysis operations in Germany. Those who have investigated these processes believe that they are able to show progress in Germany due to the peculiar economic situation there, but that they would not be successful in the United States. Dr. Williamson made an extensive survey of the possibility of producing sugar and alcohol from wood waste in California and decided it would not be profitable for his company to produce alcohol from wood under existing economic conditions.

At the Idaho School of Forestry the problem of coalescence and plasticization of sawmill wastes are being investigated. The studies are aimed primary at producing structural or semi-structural materials rather than plastic powders for the molding of small objects. These studies may be grouped under three headings (1) Coalescing wood particles by surface adhesion, (2) plasticizing wood by reactions with the lignin constituent, and (3) making a homogeneous moldable material by gelatinizing the entire wood substances.

It has been found that ground sawdust and mill waste may be coalesced into hard dense products under proper conditions of temperature, pressure, moisture, and other factors, without the addition of any chemical binders. Products have been made in this way which are stronger than the original wood. It has a specific gravity of 1.35 to 1.40. Removal of the natural resins causes a marked increase in strength, indicating that surface forces are partly, if not mostly responsible, for the coalescence.

While molded products appear to have interesting possibilities several fundamental and technical problems still need to be solved before they can pass the laboratory stage.

The lumber industry is just beginning to realize the value to itself of research on the chemical utilization of wood. Surveys of possibilities and programs for research are being worked out by a number of lumber companies in the United States, and at least two already have research laboratories and staffs working on waste utilization.

Pulp for paper and fiber boards, the production of synthetic construction materials from sawmill wastes, and non-merchantable species, and the pressing of inferior softwood lumber into hard, dense, attractive "hardwoods" are receiving attention by the industry. Various extractions, such as tannin from western hemlock bark, arabogalactan, a carbohydrate gum in western larch and a number of organic chemicals and preservatives from redwood extract are being investigated. In conjunction with other byproducts such as insulating material and pulp, some of these may prove profitable to manufacture.

Paper Mill Maintenance

By L. B. ROGERS,
CHIEF ENGINEER
CHAMPION-INTERNATIONAL CO.
LAWRENCE, MASS.*

MAINTENANCE in a paper mill is different in several important respects from that in other types of plants. This of course is due in part to the fact that paper mills run 24 hr. a day and that the results are likely to be particularly wasteful if there are any interferences with the smooth operation of the machinery. For these reasons much, if not most, of the routine work of keeping up the equipment must be attended to on Sundays when the mill is shut down. The manner in which this is done at the Champion-International mill at Lawrence, Mass., has worked out satisfactorily, and has been kept on a simple basis.

As regards the electrical equipment special attention is given to the paper machines and the super-calenders. The electricians check up every Sunday on the paper machine motors and controls. This means cleaning and adjusting the contactors, cleaning the carbon pile regulators (which is about all the attention the latter require) and cleaning the control boards. The d. c. motors are also cleaned every Sunday and special attention is given to the commutators and brushes. The super-calender controls are cleaned and adjusted as well.

All motors in dusty places such as those in the coating room are blown out with compressed air on Sundays and those in the chip room are similarly cleaned every day on account of the accumulation of sawdust. In particularly wet locations it has been found to be well worth the extra cost to install totally enclosed fan cooled motors. They have been used in the wet places where difficulty had been experienced with ordinary motors, and although they cannot stand as much overloading as open motors it is not a difficult matter to meet this condition. In fact it is much less difficult than maintaining open motors in some locations. Other motors which need protection, but where the conditions are less severe, are provided with covers to shield them from dripping or other sources of moisture.

Except for those motors which drive the paper machines and the supercalenders the routine maintenance man covers motors only about once a month. Out of the 275 motors in the plant only about six failures occur in a year.

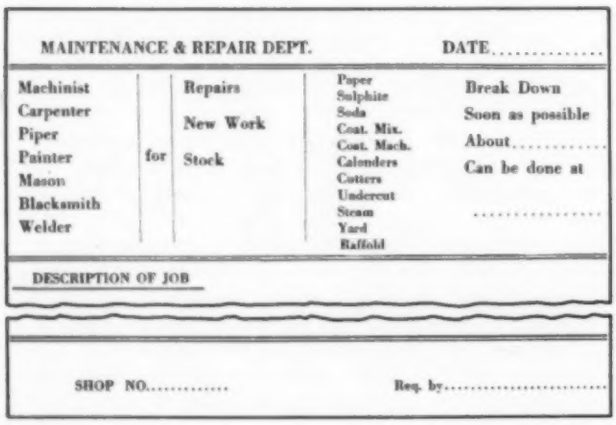
A practice which has been found to be useful, is to have a card for each motor in the plant. In addition to having the usual motor data on these cards it is customary to enter the records of the megger tests made approximately every four months. In this way it is an easy matter to check any progressive deterioration in the insulation resistance, and when this approaches the danger point to pull out the motor and clean it. With the help of a spray gun insulation is usually brought back to where it belongs. If for any reason this is not effective the motor is sent to an outside repair shop. Also, at the time of the megger tests, the clearances, bearings, etc., are checked in order to determine the condition of the motor. These results too are entered on the card, and of course if anything needs to be done it is attended to before actual trouble occurs. These tests and checking are in addition to the regular routine check-ups.

Another matter which has saved a great deal of trouble is the use of lead covered conductors for the control leads on the paper machines where the push buttons are mounted on the machine. Before this was done the insulation on these broke down too frequently because of deterioration due to the unavoidable presence of moisture in the conduits.

A complete machine shop forms an important adjunct to the maintenance department. The equipment consists of five lathes of different sizes, a planer, shaper, two drill presses, a blacksmith shop and a wood working shop with a rip saw, band saw and planer. There are also two portable electrical welding outfits and two acetylene welding outfits. Of the two electrical welders one is motor-driven and is used mainly in the repair shop. The other is driven by a gasoline engine and this is used around the plant and yards where it is more convenient to take the welder to the work, which is often in places where it might be inconvenient to find an electrical outlet to supply power for the motor-driven equipment. The acetylene torches are used largely for cutting.

When anything goes wrong with the mechanical equipment the foreman of the department involved makes out a card like the one shown in the illustration and sends it to the master mechanic, who also is in charge of the machine shop. The manner in which this card is filled out is simple. For instance, suppose that some bolts have broken on one of the paper machines and that a machinist is wanted to make the repairs. The foreman of the paper machines will then check "Machinist" in the first column, "Repairs" in the third column, "Paper" in the fourth and "Breakdown" in the fifth. This means that the paper machine has had to stop and as this is a serious matter the master mechanic will get a machinist on the job at once even if he must be taken off other work. In the space under "Description of Job" the foreman will note that bolts have been broken, so that the machinist will have some idea what tools to bring with him and perhaps be able to save some valuable time. In the case of a repair job which is not a breakdown it might be more convenient to have it done when the machine is shut down for another reason. In that case the time is written after the heading "Can be done at . . ."

An SOS from foreman to master mechanic



* In collaboration with Francis A. Westbrook.

By R. LLOYD-ROBERTS
CHIEF LABOUR OFFICER,
IMPERIAL CHEMICAL INDUSTRIES, LTD.
LONDON, ENGLAND

How I.C.I. Is Solving Its Labor Problems

THERE are now nearly 50,000 manual workers spread over 55 factories in the Imperial Chemical Industries. These factories vary from 10,000 employees down to approximately 50. In some of these factories there are no trade unionists, while in others the workers are 100 per cent organized. Over all, however, less than 50 per cent are trade unionists. The company deals with about 20 unions—3 of them representing the manufacturing and servicing departments, and the others the craftsmen and machinists employed on maintenance and construction work.

That then is I.C.I.'s problem—to keep contented a scattered payroll of 50,000 and to maintain friendly relations with 20 unions while, quite incidentally, of course, managing the works and making a reasonable profit.

When the company originally set out to face this problem the first thing that was done was to recognize that it could not be dealt with as a sideline—it must be treated as a major issue along lines just as deliberately studied and executed as those pertaining to technical and commercial matters. Under the old-time method, labor was merely the concern of the plant manager, who simply "hired" it and "fired" it from day to day, and nobody thought anything about it unless and until there was a threat of a strike.

That is not so with this company. All labor matters are in the care of a specialized department responsible direct to the board of the company. It is the duty of the labor department to secure the uniform administration of the board's labor policy throughout all plants. It does so by means of group labor officers attached to the various manufacturing groups and these group labor officers in turn have plant labor officers at each plant. The central department in London deals with the group labor officers whose business it then is to ensure that their plant labor officers carry out the company's policy in the individual plants. The plant labor officers are responsible to their respective plant managers for the proper conduct of labor relations in that plant.

No undertaking can expect harmonious industrial relations unless those relations are governmed by a definite policy emanating from the Board Room and thoroughly understood and appreciated in regard to all its implications by the various ranks of management down the line.

E. K. Hall emphasized this nearly twenty years ago. He described the message of the four C's—Contact, Consultation, Confidence and Cooperation. In fact, these form the basis of the company's labor policy.

There can be alternative kinds of labor policies. One is based primarily on the wage theory. Those who adopt that particular policy believe that the wage packet is the only bond between the employee and the company. Their

conception of industrial relations is a purely materialistic one and they consequently act on the assumption that in order to get the best out of a man, all you have to do is to put more money into his pocket.

The upholders of that policy are treading a dangerous path because they are appealing to the lowest instead of the highest instincts of the workman and a relationship so based will inevitably lead to conflict sooner or later.

The other form of labor policy envisages a much nobler conception of human nature and of the function of industry in our social economy. It may be termed the idealistic theory of industrial relations as opposed to the materialistic one to which has been referred. The basic idea at the root of this preferred form of policy is that industry exists to render service to the community and that it does so by means of the joint activities of the investor, the management, and the manual worker, each of the three parties naturally expecting to receive a fair reward for its contribution.

It is imperative that this conception of industry must be frankly accepted for the future. The old idea of capital hiring labor both of hand and brain to conduct an enterprise for the profit of the capitalist is going to be superseded. The world is fast moving to the next stage under the capitalist system when labor (using the term in its widest sense) will hire capital for a fixed wage and will itself retain the profits, allocating them in some ratio as between direction, management and operation.

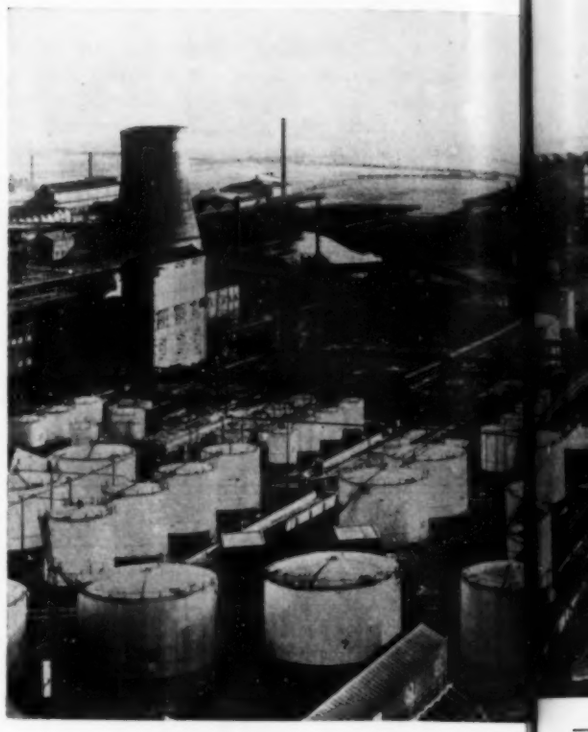
The schoolmaster has been abroad, with the result that the workman of 1937 is a very different individual from his predecessor of earlier generations. He now thinks for himself; he reads what others think; he listens to others who have read and thought more than he has. He now knows that he has a contribution to make; he realizes that labor is just as essential to industry as is the capitalist, and knowing all this, he demands what he conceives to be his proper place in the scheme of things.

If the capitalist structure of society is to continue, the believers in that structure must see to it that it can be adapted to meet these legitimate desires and ambitions of the working-man of today. Hence this company has adopted a labor policy appropriate to what it conceives to be the needs of the present time.

This company believes it is so appropriate, because it attempts to fulfill in some degree the new conception of industry to which has already been referred, and seeks to make the ordinary manual worker feel that he is a real participator in this enterprise. Quite simply, this company tries to make the worker realize that he is working *with* it rather than *for* it. It is believed that only by the establishment of such an understanding with the company's employees can it secure their intelligent co-operation to the fullest extent. The pursuit of an idealistic rather than a materialistic labor policy is the only way to reconcile the outlook of the modern workman with the requirements of modern industry.

The next points to be considered are the implications of the philosophy underlying the company's behavior towards its people and its practical expression.

The first implication is that the company does not base its wage policy on the sole consideration of supply and demand. It has established throughout the chemical and explosives plants a national minimum rate which it believes to be at the moment a fair rate in relation to its own prosperity and to the purchasing power of money. The company is aware that in many of the areas in which its plants are situated, it could obtain labor at lower rates



Coal hydrogenation plant of Imperial Chemical Industries at Billingham-on-Tees gives employment to 11,000 men

but it declines to take advantage of that important fact.

I.C.I. has, of course, many rates superior to the minimum and because it is anxious that men should be paid appropriately for skill and responsibility it has for the past 16 months been engaged in a meticulous "point-rating" of all jobs with a view to ensuring (a) that it does not apply the minimum rate to other than laboring jobs and (b) that jobs superior to that of the laborer are correctly rated in relation to each other. This was entirely a voluntary undertaking on the company's part in pursuance of its general wage policy.

Another indication of the I.C.I. attitude is that it settles the general wage position at all factories by negotiation with the appropriate trades unions, even though—*and this is the important point*—those unions may not have a single member in a particular factory.

In the company's unorganized factories it could perfectly well settle wages and conditions direct with the workers themselves through its works council machinery. It does not do so, however, because it believes that those workers are not in any real sense in a fair economic position to bargain with the company. I.C.I. believes they need the protection afforded by trade unions and union officials who are experienced in wage negotiations and who know the general wage position in the country. The company believes that, however honest its intentions as a company, it needs the salutary check on it imposed by these external bodies. I.C.I. knows that, having regard to the relations which exist between it and its workers, it could many times adjust wages and conditions against the workers, or refuse reasonable claims for improvement on the plea of necessity and because of their confidence in the company they would readily submit. In order to prevent any possibility of abuse of this confidence, there-

—from the coal mines through to the filling stations. The company employs nearly 50,000 manual workers

fore, the company invariably conducts such negotiations with the unions and so submits to the challenge to make good its case.

I.C.I. establishes or varies wages and conditions, such as overtime rates, etc., in negotiation with the trades unions and, consequently, these matters are outside the purview of our works councils, except in a special case by written consent of the union or unions concerned.

The second implication is that the company should do all it can to increase the sense of security of the worker in his job and in his wage. Apart from the company's commercial people's constant efforts to even out their demands on the production departments, I.C.I.'s staff grade scheme is its outstanding contribution to this security sense. Under that scheme, every employee with five years' service is eligible to put on staff conditions. These include a guaranteed minimum wage throughout the year, unless four weeks' notice is given to vary it, or to terminate the contract; that guaranteed wage is paid during absence through sickness or accident up to six months. The company's experience with this scheme has completely belied the fears of the pessimistic prophets that the company would get a lot of malingering, and the intention to maintain it and even expand it is entirely justified by the response the workers have given in the form of intensified effort and co-operation.

I.C.I. has also made a contribution towards the wage security of the general body of workers who are not on staff grade by protecting their weekly wage during the weeks when the six national bank holidays occur. The intervention of one or more of these days in any week shall not operate to reduce the workers' normal wage.

The I.C.I. pension plan also contributes to the security sense and, in addition to providing invalidity and old-age annuities, it provides generous cash payments if the worker loses his job through no fault of his own, or dies in harness.

There is no doubt that employers in England must concentrate more and more on finding ways and means to pay the worker a regular weekly wage throughout the period of his contract.

The third implication of the company's labor philosophy is the one which compels it to provide adequate channels of approach from the management to the men, and *vice versa*. It is done mainly by the works council plan. This differs somewhat from American employee representation plans.

This plan has three parts—55 works councils at the individual plants; 9 group councils consisting of delegates from works manufacturing the same or allied products—thus the Alkali Council, the Explosives Council, the Metal Council, etc.; and thirdly, the Central Council, consisting of delegates from each of the group councils. The works manager is chairman of his works council; the chairman of the group board is the chairman of the group council; and the chairman of the company (Lord McGowan) is chairman of the Central Council. The works councils meet monthly; each group council and the Central Council meet twice a year. Every council is a 50/50 body—half management nominated by the company and half workers elected by secret ballot.

As election time approaches, notices are posted in the plants announcing the vacancies and inviting nominations. The same day all the unions known to have members in that plant are invited to submit nominations if they so desire. Every candidate must have five years' service with the company.

The workers' representatives have the right, if they so desire, to invite a union official to the meeting of the councils, but this has happened only twice in something approaching 10,000 meetings, thus showing that the workers realize the domestic nature of the council.

The meetings are held on a fixed day each month, and this day may not be changed except for an important reason. We regard it as important that the rank and file should know that on say, the last Friday in each month, their representatives will have the opportunity of raising any matters requiring attention.

At each meeting, the chairman of a works council tells the members as much as he possibly can of the affairs of his plant: the state of the order book, any difficulties of competition, etc. He describes any new process or product, or explains what alterations are contemplated. The chairman of a group council does the same thing on a wider basis for his group, while Lord McGowan at the Central Council meetings gives a general review of the position of the company at home and abroad, in retrospect and prospect. In fact it is the considered policy of the company to break down that traditional "hush hush" in its affairs and to take the workers into the completest practicable confidence.

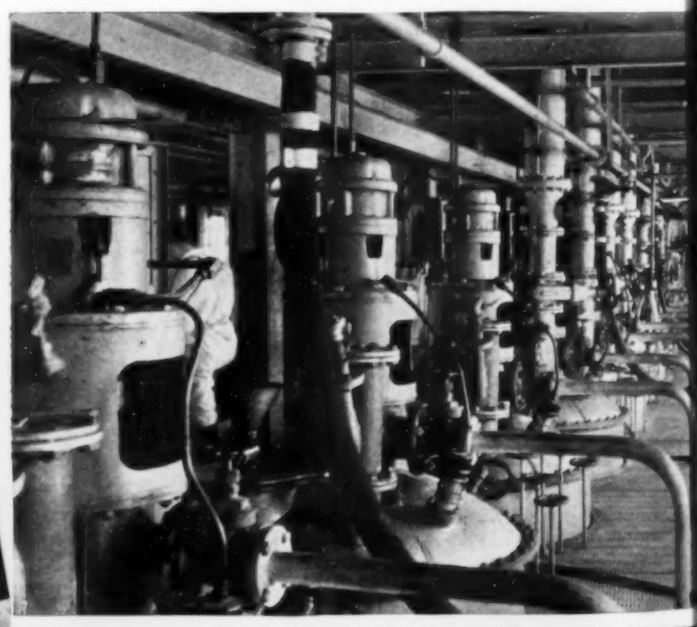
These councils are a most powerful influence in promoting understanding between management and men. They not only educate the workers in management problems, but educate management in the company's labor policy and act as an effective check on any manager who may be inclined not to treat his individual workers with sympathy and understanding.

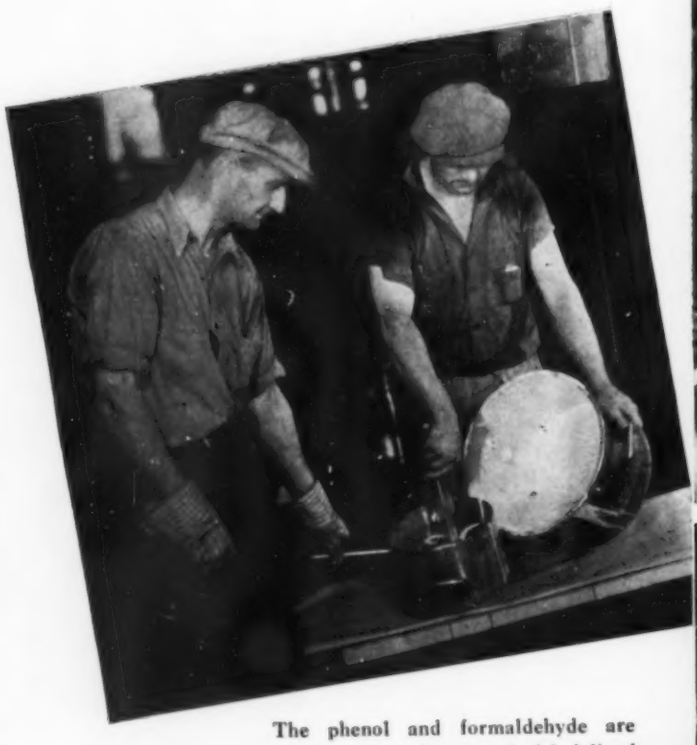
The complete article, of which this is an extended abstract, will appear in the November issue of *Factory and Industrial Management.—Editor.*

MAKING SYNTHETIC RESINS

Cast phenolic resins have made rapid strides in recent years. One of the largest plants in the world devoted to the production of this type of synthetic resin is that of the American Catalin Corp. at Fords, N. J. It has an annual capacity of more than 5,000,000 lb. This modern plant with its corrosion resistant equipment is operated under very exacting control. All processes are carefully timed and in most cases the control of temperature and pressure is automatic. An autographic record is kept of the temperature and pressure maintained in the kettles and temperature in the curing ovens, so that the history of each batch is not only closely controlled but easily traced by reference to the records. Color, degree of clarity and character of mottling of the resin are extremely important as a large part of the output is used for decorative purposes.

Some sheet stock is sliced from large blocks when it is in a partially cured condition. The sheets are returned to curing ovens to be hardened. All photos courtesy of Warner Brothers Vitaphone Pictorial Revue.





The phenol and formaldehyde are processed in a battery of nickel lined kettles which are equipped with steam jackets. When the mass attains the consistency of molasses it is the color of honey. Dyes are then added and thoroughly mixed into the resin. It is drawn into ladles from which it is poured into the lead molds. When mottled effects are desired one or more colors are carefully added to the colorless resin in a ladle.

Process Control Features Meeting Of Electrochemists

EDITORIAL STAFF REPORT

THE ELECTROCHEMICAL SOCIETY held its fall meeting at St. Louis, Mo., October 13 to 16. Visits were made to the Laclede-Christy Clay Products Co., Monsanto Chemical Co. and the Wagner Electric Co. and other plants. Technical sessions were held on pH determination and process control, rectifiers and D.C. transmission, electrothermics and electro-organics, and electroplating.

The opening session was devoted to automatic electrochemical control of chemical manufacturing processes. G. A. Perley of Leeds and Northrup Co. presided. Industrial pH control with the antimony electrode was discussed by W. N. Greer of the same organization. The sugar industry has been progressive in applying pH process control. This applies particularly to the beet and raw sugar industries. Increased use is being made of treatment with compressed SO_2 either liquid or gas after carbonization, but prior to final filtration before crystallizing the sugar from the concentrated juice. The SO_2 is introduced into a pipe line carrying the juice or into a small reaction chamber. The rate of juice flow is governed by evaporation rates in the process just prior to treatment and by withdrawal of juice of filters. It is obvious that SO_2 demands are subject to appreciable and sometimes rapid changes. It is only by the continuous automatic regulation of the SO_2 that this advantageous system can be safely operated. The antimony electrode has operated successfully on those sulphured juices. In the production of "plantation white," or with some special refractory juices, sulphitation is often resorted to. The only limitation of the antimony electrode encountered here has been an error in recorded pH value when SO_2 content exceeded 1 g. per l. at pH of approximately 3.9.

This same type of electrode is being used in paperboard mills for controlling addition of alum to stock. pH not only affords a good means of controlling proper alum addition for sizing, but also makes for better control of other board characteristics such as color, and usually with appreciable decrease of quantity of alum used.

The limiting factors encountered with the antimony electrode in water treatment are a maximum residual chlorine content of 0.5 p.p.m. at point of measurement and a gradual scaling of the electrode with carbonate in lime softening installations. In the latter case the electrode surface must be cleaned every eight to twelve hours.

Three related problems in the use of halide reference half cells for pH determinations was the subject of a paper by Walter J. Hamer of the National Bureau of Standards. These are (1) the construction of liquid junctions, evaluations of their potentials, and a pH method which eliminates both; (2) the calculation of the standard potentials of the calomel electrodes from measurements of the electrodes in the three distinct environments; strong acids, weak buffers, and standard states; and (3) the applications of reference half cells to particular problems and the proper choice of potential values, suitable for different types of service.

The general theory of the antimony-antimony oxide electrode was dealt with by T. R. Ball, associate professor of chemistry, Washington University. Under very rigorously controlled conditions the electrode functions according to the Nernst equation. The failure of the polished cast electrode to conform to theory is doubtless due to non-uniformity of the oxide coating. It is claimed by some that the metal contains Sb_2O_4 formed during casting, also that surface air oxidation results in Sb_2O_3, Sb_2O_5 plus a peroxide of unknown composition. These factors affect the potential. Electrodes made of metal from three different sources showed no variation which could be attributed to the source. An empirical formula may be derived for the oxide electrode by which pH values may be calculated. The accuracy is about $\pm$ 0.06 between pH 2 and 7. If the oxide coating is replaced by sulphide, the limit is extended to about pH 10 on the alkaline side and the variation between electrodes is decreased.

A vacuum-tube potentiometer capable of measuring glass electrode potentials to 0.03 millivolt, even when the internal resistance is 2,000 megohms or more, has been constructed, according to J. L. Gabbard and Malcolm Dole of the University of Kentucky and Northwestern University respectively. In Part I of the paper, glass electrode errors for the ordinary sodium glass electrodes at 30 deg. C. are tabulated and compared with similar errors at 25 deg. C. In Part II the properties of electrodes made of special lithium glass found by the Russian workers, Ssokolov and Passynsky, to be superior to the glass recommended by MacInnes and Dole, are given. These lithium glass electrodes have

enormously high resistances and comparatively large and unstable asymmetric potentials; they fail to respond accurately to pH changes even in the acid and neutral range. There is no evidence of the superiority of electrodes made from lithium glass and the authors were at a loss to explain the discrepancy between their results and those of the Russian investigators.

Various methods of detecting direct potentials in circuits of high resistance were discussed and appraised by R. H. Cherry of Leeds and Northrup. A new instrument for such measurements was described and a variety of its applications indicated. With this instrument and a robust galvanometer of moderate sensitivity, it is possible to detect potentials to better than 0.1 millivolt in circuits having resistances in the order of 10^{11} ohms.

In a discussion of the standardization of the pH scale David I. Hitchcock of the Yale University School of Medicine stated that as is well known, the values recorded for the hydrogen ion concentration of a solution are based on an arbitrary scale. A new approach to the problem is made using buffer solutions, each containing a weak acid of accurately known ionization constant, together with one of its completely ionized salts. pH values for a number of reproducible standard solutions were determined: 1.085 for 0.1 N HCl; and 4,648 for 0.1 N CH_3COOH in 0.1 N CH_3COONa.

The error of the glass electrode in lithium and sodium aqueous solutions over an extensive pH range was measured at 10 and 50 deg. C. and compared with the data at 25 deg. C. by Dole and B. Z. Wiener of Northwestern University. The alkaline error is greater at the higher temperature and less at the lower temperature, but the acid or water activity error scarcely changes with the temperature, depending, in agreement with the "water electrode" theory of Dole, only on the activity of the water at any particular pH. The alkaline error increases with the temperature in accord with the requirements of the statistical equation of Dole insofar as the order of magnitude is concerned; the "Q" quantities, however, instead of being strictly constant change slightly with the pH, salt concentration and temperature. The data given have the practical utility of being applicable as a correction factor to glass electrode measurements at temperatures other than 25 deg. C., a pH correction table being included in the paper.

Devices for Supplying Direct Current

The second session, under the chairmanship of J. W. Marden of the Westinghouse Lamp Co., dealt with new static devices for supplying direct current for electrochemical processes. Thyratrons for grid controlled rectifier service were discussed by G. H. Rockwood of the Bell Telephone Laboratories, New York City. It is common knowledge that the output voltage of a rectifier fluctuates with changes in load current and supply line voltage. Frequently these fluctuations are so large that means must be used to correct them. This is particularly true when the rectifier feeds a load having a high back electromotive force and a small resistance, such as a storage battery. The facility with which the output voltage may be controlled by the use of thyratrons as the rectifying element has encouraged the design of tubes especially suited to this purpose. There is available a variety of circuits such that the output voltage of a rectifier may be made to obey any desired law. The successful application of these circuits depends upon the degree of reliability of the thyratron tubes used in them. To be most successful the tubes must possess certain characteristics. This paper gives a brief review of the operation of grid-controlled rectifier circuits, discusses the requirements which such circuits impose on the tube characteristics, and describes a particular type of thyratron with mercury-plus-argon filling which has proved especially useful in such rectifiers.

Theory and phenomena of high current densities in low pressure arcs was the topic of a paper by Lewi Tonks of the General Electric Co. When a low-pressure arc, considered as an electrical conductor, is "overloaded", it opens circuits with a suddenness which can create surges of many thousands of volts. Starting from the theory of the arc for moderate current densities, four factors are seen to be possible causes of such a limitation; namely, the longitudinal pressure gradient, a pressure difference arising in double sheaths, the transverse pressure gradient, and the magnetic pinch effect. These were discussed relative to the scant experimental material available and found to be of the right order of magnitude to form the basis of an explanation in various cases.

Copper oxide rectifiers were discussed by L. O. Grondahl, and mercury arc rectifiers and ignitions by J. H. Cox and D. E. Marshall, the rectifier—a versatile conversion unit, by C. C. Levy, Westinghouse Electric & Manufacturing Co., and potential distribution in high current carbon arcs in air by A. H. Heatley and B. S. Soanes of the University of Toronto.

Electrothermics and Electro-Organics

In the session on electrothermics and electro-organics, presided over by William G. Harvey of the Aluminum Co. of America, president of the society, Dr. Walter S. Landis of American Cyanamid Co. discussed his experience with the production of magnesium and zinc metals made in the electric furnace, an entirely new process. In a closed electric arc furnace the reaction $ZnO + C = Zn + CO$ or the reaction $MgO + C = Mg + CO$ is carried out. Zinc vapor or magnesium vapor collects in a condenser and is subsequently redistilled in a second electric furnace. The quality of the zinc produced is equal to the best retort grade and the quality of the magnesium metal is superior to the electrolytic grade.

The electrolytic reduction of *n*-valeric aldehyde to *n*-pentane was reported upon by Sherlock Swann, Jr., research assistant professor of chemical engineering and E. W. Field, one of his senior students at the University of Illinois. The electrolytic reduction of *n*-valeraldehyde to *n*-pentane in acid solution was studied at cathodes of cadmium, tin, lead, mercury, zinc, aluminum, copper, nickel, and iron. Cadmium, lead, and zinc cathodes gave the best results. The effect of impurities in a lead cathode was discussed. The influence of temperature on the electrolytic reduction of methyl *n*-propyl ketone to *n*-pentane was shown. The electrolytic reductions of *n*-valeric aldehyde and methyl *n*-propyl ketone were compared.

On investigating the electrolytic production of beryllium-copper alloys by discharging beryllium into molten copper serving as cathode in a fused beryllium oxyfluoride bath, Colin R. Fink, head of the Division of Electrochemistry at Columbia University and secretary of the Society, and Tsing-Nang Shen, a graduate student, found

that the efficiency of the cell increased as the quantity of beryllium carbide formed was reduced. The conductivity of the electrolyte composed of equal parts of beryllium oxyfluoride and barium fluoride is markedly improved by the addition of sodium fluoride. Of the various baths tried, the one consisting of 50 parts by weight of beryllium oxyfluoride, 34 parts of sodium fluoride, and 16 parts of barium fluoride gave the best results. The current efficiency on the basis of beryllium metal deposited was 48.7 per cent and the yield was 0.863 gram of beryllium per kw-hr. Alloys containing over 3 per cent beryllium were thus produced.

Experimental proof was submitted by Willy Machu of Austria to show that the electrochemical or overvoltage theory heretofore advanced to account for the action of inhibitors in pickling solutions does not hold true. Results indicate that, due to adsorption, a film is formed over both the metallic iron areas and the oxidized or sealed areas. However, the practical success in the use of inhibitors is due to the greater adsorption of inhibitor at the metallic areas as against that at the oxidized or scaled areas. Accordingly, since the time of diffusion of the acid ions through the inhibitor film will be the longer the greater the thickness of the film, the oxidized or scaled areas will be more readily attacked by the acid than the metallic areas.

Determinations were made by W. W. Stender and B. P. Artamonow of Leningrad, U.S.S.R., of the rate of corrosion of electrolytic iron, cast iron, and sheet iron in concentrated alkali solutions (NaOH and KOH), fused alkalis, and in alkali lyes during the process of fusion. It was found that the rate of corrosion depends upon the temperature, the concentration of alkali, and the concentration of chlorine ions and chlorate ions in the solution. The effect of cathode polarization on the rate of corrosion of sheet iron and cast iron in alkali solutions of different concentrations at various temperatures and various chlorine and chlorate ion concentrations was studied. It was shown that for the electrolytes examined, cathode polarization ensures protection of the iron against corrosion, and that the ratio between cathode current density without applied cathodic polarization and current density with applied cathodic polarization (completely protected cathode), varies between the limits 0.20 to 0.37 amp./m^2. During the process of fusion of the alkali in an iron container and also after fusion, cathodic polarization gives only a partial protection against corrosion.

The solvent degreasing process for the removal of oil and grease from articles prior to being electroplated or otherwise "finished" was described in some detail by W. W. Davidson, vice-president of Detroit Rex Products Co. Fundamental principles of equipment design and the characteristics of the stabilized, non-flammable solvents were discussed.

A quantitative study was presented by Fink and H. B. Linford of Columbia University, of the high effect on the metal electrode potential upon rotating the electrode at high speeds (8,000 r.p.m.). Two metals were investigated; copper and zinc. As the speed of rotation increased, the potentials of both the copper and the zinc became more noble—to as much as 9 to 15 millivolts respectively at 25 deg. C. The magnitude of this change in potential depends upon the ion concentration. Results are in accord with the theory of Procopiu: Rotation brings about a change in the ion concentration in the liquid layers next the electrode. The authors observed a distinct rise in potential (becoming more noble) whenever the motor rotating the cathode was suddenly stopped.

Among the many other interesting and valuable contributions to the meeting were: the electrodeposition of tin, by L. E. Stout and A. H. Baum of Washington University; the composition of some complex metallic cyanides, (potassium silver cyanide) by R. L. Dorrance, R. C. Ellis and A. D. Matheson of Queens' University, Kingston, Ont.; electrolytic processes in the magnetic field by Fink, and Myron A. Coler.

A Cast Overlay of Corrosion Resistant Alloy

A METHOD has been developed by which an overlay of a corrosion resistant alloy can be centrifugally cast on to a mild steel base. It is said that it lowers the cost of fabrication over welding, is of the same density throughout the entire length and always wears smooth without exhibiting the undesirable service checks, cracks or rough spots. The method has been succesfully tried on pumps. Its advantages for centrifugal pump shaft sleeves and pump liquid end rods or plungers have been conclusively proved.

One installation has been made of a process plunger 7 in. in diameter and 41½ in. in length, which is in service now on a reciprocating hot oil pump at the Humble Oil and Refining Co.'s plant at Baytown, Tex. The plunger is covered by a centrifugally cast shell of a chromium boride crystal alloy of nickel (Colmonoy 6, Colmonoy, Inc., Los Nietos, Calif.) which is resistant to sulphuric and hydrochloric acids and wears smooth in service.

By fusing a crystalline combination of metallic borides with such base metals as nickel, steel and cast iron, it was found that alloys can be produced that possess interesting physical characteristics, as well as resistance to corrosion and abrasion.

One of these alloys, consisting of 75 per cent nickel and 25 per cent of the metallic boride crystal combination, was found to be resistant to sulphuric acid and other chemicals, and to abrasion. Further, it was found to have the particular properties necessary so that it could be cast on to a steel base and solidify interalloyed with or bonded to the steel with a comparable bond to that produced in the welded-on overlay or hard facing operation. This particular alloy shows every indication of being suitable for such parts as pump sleeves and pump plungers.

This alloy has a:

Hardness—54 to 58 Rockwell C—534 to 587 Brinell
Density—7.80
Coefficient of thermal expansion—0.00000868
Melting point on cooling—thickens at 1990, hardens at 1800 deg. F.
Compression strength—193,000 lb. per sq.in.
Tensile strength—25,600 lb. per sq.in.

But the new metal's usefulness doesn't stop there. It may be utilized as an alloying element for other base metals and the products thus formed are equally interesting in the corrosion resisting field.

Present-Day Methods for Dissolving CELLULOSE DERIVATIVES

By KENNETH S. VALENTINE
THE PATTERSON FOUNDRY & MACHINE CO.
EAST LIVERPOOL, OHIO

CELLULOSE DERIVATIVES are today of vast and increasing importance to the world, and many industries have been built on the production of one or another of them. The rayon industry is an outstanding example. Each of its four types, i.e., viscose, acetate, cupra-ammonium and Chardonnet (or nitrate) yarns, starts with cellulose, converts it into a derivative, dissolves that derivative in a suitable solvent and then removes it from solution, either as the derivative or as regenerated cellulose. Cellophane and similar wrapping materials come under the same classification, as they are prepared either by the viscose or acetate process. Pyroxylin lacquers, photographic film, and so-called artificial leather are other products employing either cellulose nitrate or cellulose acetate, where substantially the same procedure is followed. The important fact is that in all cases these compounds, at one stage of the process, are dissolved.

Though these various solutions differ greatly in viscosity, nevertheless they must all be classed as viscous solutions. Except in the lacquer industry they will vary in viscosity anywhere from 15,000 to 300,000 centipoises. For lacquer they run over a much wider range, i.e., from 1,000 to 2,000,000 centipoises.

Most of the equipment now in use for preparing these solutions is newly developed—a rather fortunate situation for the industries mentioned. The chief reason for this is the comparative youth of the industries themselves, as well as their recent mushroom growth. Up to 20 years ago not one of these industries, except possibly the film industry, was of any size. Pyroxylin lacquer had not come into use and rayon was in its infancy. When pyroxylin jumped into prominence about 1920 to 1923, it was natural to borrow old types of machinery from other industries. The film industry at that time was quite generally using machinery which had been imported from Europe. As for rayon, with only one exception, every important rayon manufacturer founded his initial operations on European dissolving equipment. One by one, however, all of these plants in all of these industries have shifted from the original inefficient types to the new and better ones. This, as has been said, has been made easy by the enormous expansion of all of these industries. In 1920 rayon production was about 10,125,000 lb., and in 1936 it was 277,626,000 lb.

Naturally, when a new machine is tried out and found to be successful, from that time on only the new type is used. It is an absolute fact that in every case, in every industry where the newer type dissolving equipment has been tried out and put into actual commercial use, there has been no turning back to the older type. The newer type has completely superseded the older type in all plant expansion. A reasonable estimate would be that in the pyroxylin, as well as in the rayon and film industries, more than 50 per cent of the total production is being turned out in the newer type dissolving equipment.

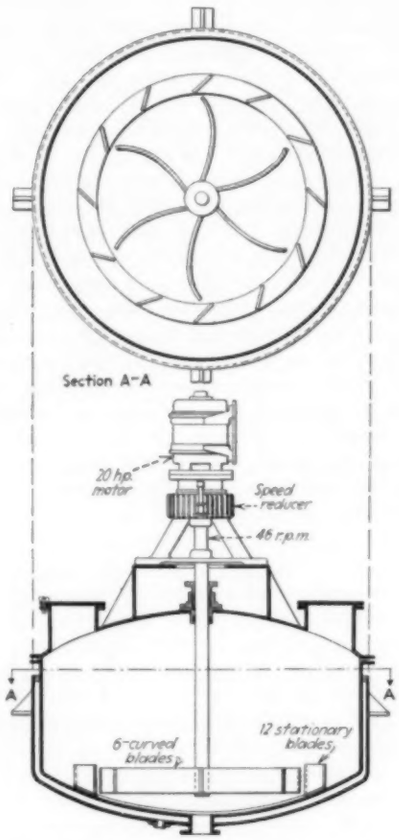


Fig. 1—Vertical cotton dissolver with turbine and deflecting blade ring

For more detailed consideration a study of dissolving equipment must be divided into three parts: (1) cotton dissolvers (for nitrocellulose), (2) cellulose acetate dissolvers, and (3) xanthate dissolvers.

Cotton Dissolvers

Cotton dissolvers or cotton cutters is the general name given to the equipment in which nitrocellulose is dissolved for use as film solution, artificial leather or pyroxylin lacquer. The general characteristics of all of these solutions are the same in that the resulting product is a liquid rather than a plastic, although this liquid varies greatly in viscosity, depending upon its exact use. The film industry, as well as the artificial leather industry, holds to a fairly narrow range, i.e., from 30,000 to 120,000 centipoises, for here the finished

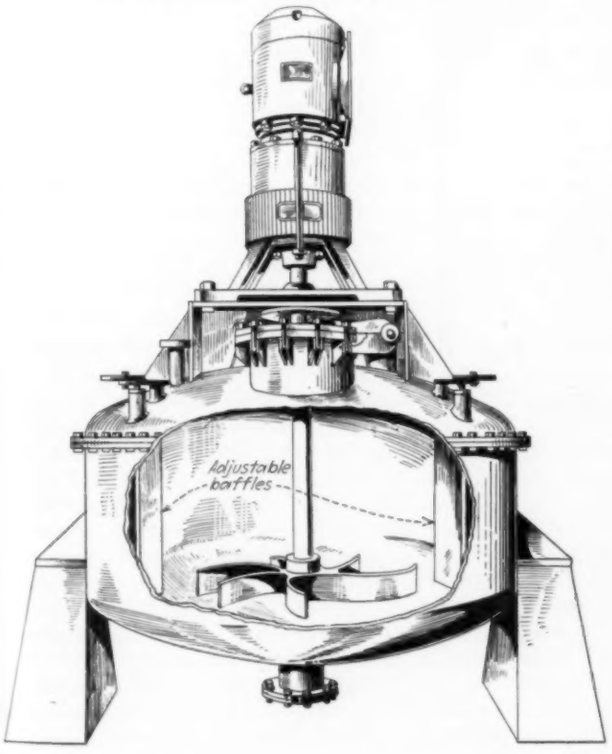
product must have sufficient viscosity to form a sheet when put on the "wheel" or on the coating machine. On the other hand, the viscosity of lacquer solutions varies from less than 1,000 to more than 2,000,000 centipoises, because of the varied requirements of this industry. For instance, some solutions are prepared at spraying viscosity, whereas others are made in the most viscous and concentrated form to cut down shipping weight, with the idea that some solvent will be added later by the customer. Consequently, the ideal dissolving machine for this industry is one which will operate with unimpaired efficiency over the entire range of viscosity.

The earlier equipment in use for cutting cotton fell far short of this ideal because it did not operate efficiently at any of these viscosities. One of the types in use some years ago, mostly in the film industry—and occasionally found today—consists of a rotating drum, sometimes with projections sticking out radially from the sides of the cylinder toward the center. This machine, while admittedly requiring little power to turn it over, as a rule takes from three days to a week to prepare a batch, obviously leaving much room for improvement.

The plain paddle type of mixer, consisting of a vertical cylindrical tank equipped with the usual type of vertical shaft and horizontal paddles, has also been extensively used, particularly in the artificial leather industry. While simple, it is a slow dissolver, requiring considerable power, and does not accomplish a complete dissolving.

Another older type which enjoyed considerable vogue at one time, particularly in the pyroxylin lacquer industry, is the so-called horizontal cotton cutter. This machine is a stationary horizontal cylindrical tank through which runs a horizontal shaft with stuffing boxes and external bearings at each end. To the shaft, paddles of various types are attached. Sometimes plain wooden arms are used and in other cases the blades are made of steel with toothed edges. Often, stationary fingers projecting from the sides of the tank are used between these paddles to improve the shearing action. To accomplish the work, however, these machines consume an exceptional amount of power, three or four times that which is necessary for the turbine types, and they dissolve comparatively slowly. Furthermore, it has been demonstrated that stuffing boxes below the liquid level in the case of nitrocellulose solutions are not particularly desirable.

Fig. 2—Special cotton dissolver with turbine and pivoted baffles, used for a wide range of viscosities



In recent design the trend has been toward faster and more efficient types, not only for fixed viscosities but also for the entire range. It has been determined by experimental comparison that the best type of mixing element for fast, thorough and low-powered dissolving is that based on the turbine principle—best because it is by all odds the fastest, the most efficient as to power consumption and the simplest in design. When the container is properly shaped, a turbine running at moderate speed will set up general circulation, even in the case of highest viscosities, which will reach every part of the container. The material is drawn repeatedly through the mixing element itself and the consequent quantity of shear produced on every particle of the material within the container is responsible for the rapid solution.

A widely used style of turbine cotton dissolver is shown in Fig. 1. In general this type consists of a rather flat container with one turbine located at the bottom. For low viscosities, i.e., 100 to 60,000 centipoises, a stationary deflecting blade ring is provided as shown. Under these conditions the stationary ring promotes shear and breaks up the tendency to swirl. In such a machine 1,000- to 2,000-gal. batches of half-second cotton can be dissolved in suitable solvents for lacquer solution, to a final viscosity of 30,000 centipoises, in 30 to 45 minutes. On the other hand, at times 2½ hours are required to make a film solution of the same viscosity, i.e., 30,000 centipoises, from 200-second cotton. This can be done with 8 to 9 hp. for 2,000 gal. It might also be mentioned at this point that it requires about 50 per cent more time to dissolve nitrocellulose from wood pulp than it does that made from cotton linters.

For very high viscosity solutions the type of machine shown in Fig. 1, but without the stationary deflecting blades, is used. In this case the deflecting blade ring is not only unnecessary, but is a positive detriment, as it greatly impedes the general circulation. At this high viscosity there is no tendency to swirl but there is an excellent circulation and turnover of the material. Of course the shear is greatly intensified as the viscosity increases. In fact, the shearing force is directly proportional to the centipoise viscosity of the solution.

For another class of dissolving common among many manufacturers, where the viscosity of the finished product varies over the widest possible range, a special type of cotton dissolver illustrated in Fig. 2 has been developed. This is of the usual shape and is provided with the usual turbine at the bottom of the container. However, the baffles or deflectors are located at the sides of the tank and are pivoted so as to be adjustable. When it is desired to dissolve a batch of low viscosity the baffles are swung out into a radial position. For high viscosity batches they are swung back so that they are flush with

the sides of the tank, projecting only a distance equal to the thickness of the metal. In this position they do not impede the circulation of the viscous material.

These dissolvers are sometimes constructed of special metals, such as stainless steel, to prevent the solution becoming contaminated or discolored, but usually they are made of steel or cast iron. Heat-up is sometimes undesirable and in such cases the dissolvers are jacketed for cooling during operation. They are always constructed with dished bottoms to promote circulation and often with dished tops when pressure is developed during the processing or is to be used for discharging the machines.

At this stage another special mixer is mentioned for the production of extremely high viscosities which are beyond the range where a turbine will produce circulation. In such cases a very slow speed paddle mixer with specially angled and curved paddles working between stationary baffles is in successful use. Naturally this machine is not extremely fast, but it does good work under difficult circumstances on viscosities ranging from 500,000 to 3,000,000 centipoises, preparing the solution in about 6 to 7 hours, with power consumption of approximately 15 hp. for 800 gal. at 2,000,000 centipoises.

Cellulose Acetate Dissolvers

Cellulose acetate dissolvers find their greatest use in cellulose acetate rayon production. These solutions do not vary in viscosity as widely as those in the nitrocellulose group, running somewhere between 150,000 and 300,000 centipoises. Therefore, in designing the ideal machine for this type of work it is necessary to consider only a single set of conditions, although a difficult set. The difficulty lies in the fact that the pieces of cellulose acetate being dissolved are of substantial size and hardness, although varying widely in physical structure, depending upon where the material is produced. In some cases a fairly free flowing granular cellulose acetate is the starting material. In other cases the material varies as to particle size, running all the way from fine powder to pieces like coarse knots of paper pulp as large as $\frac{1}{2} \times \frac{1}{2} \times \frac{1}{4}$ in. This material is not acted upon rapidly by solvents because of the constant tendency of the surfaces of the particles to jell over. This jell is removed only by strong shearing action or erosion, so that fresh, undissolved material is exposed to the action of the solvent.

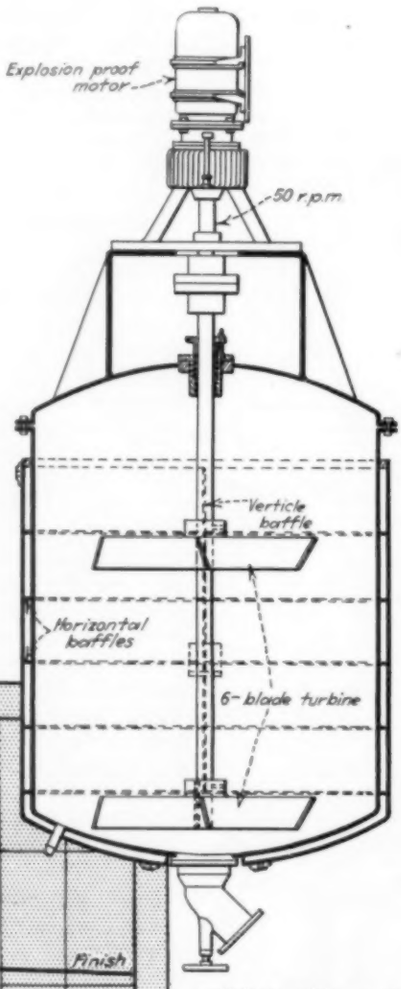


Fig. 3—Acetate dissolver with two spiral angle-bladed surbines

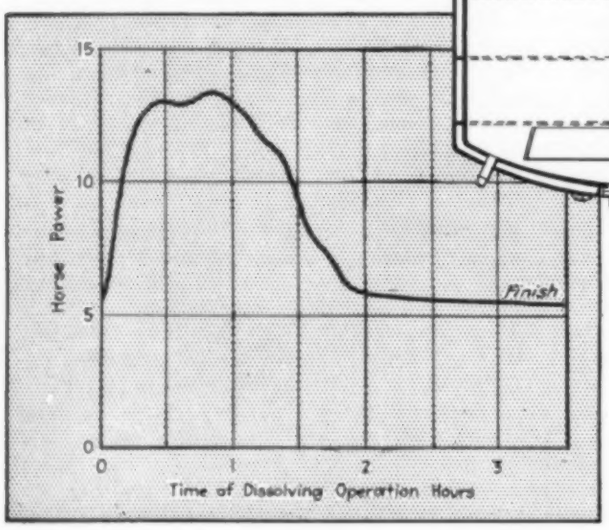


Fig. 4—Typical power consumption curve for acetate dissolver producing 1,000 gal. of finished solution at 210,000 centipoises

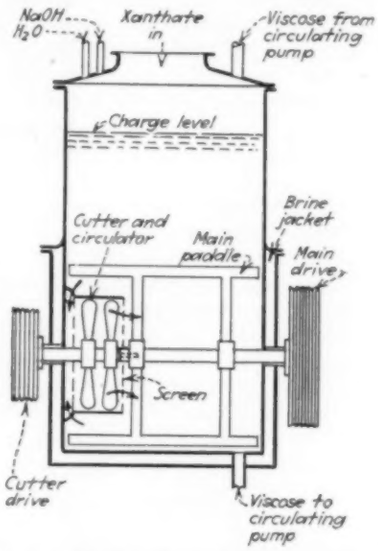


Fig. 5—Sketch illustrating principles of old style European xanthate dissolver

The older type of equipment used for these dissolving processes was based upon that used in Europe, and it has never proved entirely satisfactory. In the first place, the machines were usually built for very small batches of material, and in the second place, were based on inefficient mixing principles. One type was quite similar to the horizontal cotton cutter previously described, except that the mixing elements were installed in a semi-cylindrical trough with straight sides, rather than in a cylinder. In this the action consisted mostly of churning the material until the dissolving was slowly accomplished, with no thought of producing uniform circulation or shear throughout the entire mass. High power consumption and long time cycles were the result.

The best solution to this problem lies in maintaining the highest possible rate of circulation of the material, at the same time holding the viscosity as high as possible. A machine which will combine these two features gives the maximum rate of erosion—consequently, of

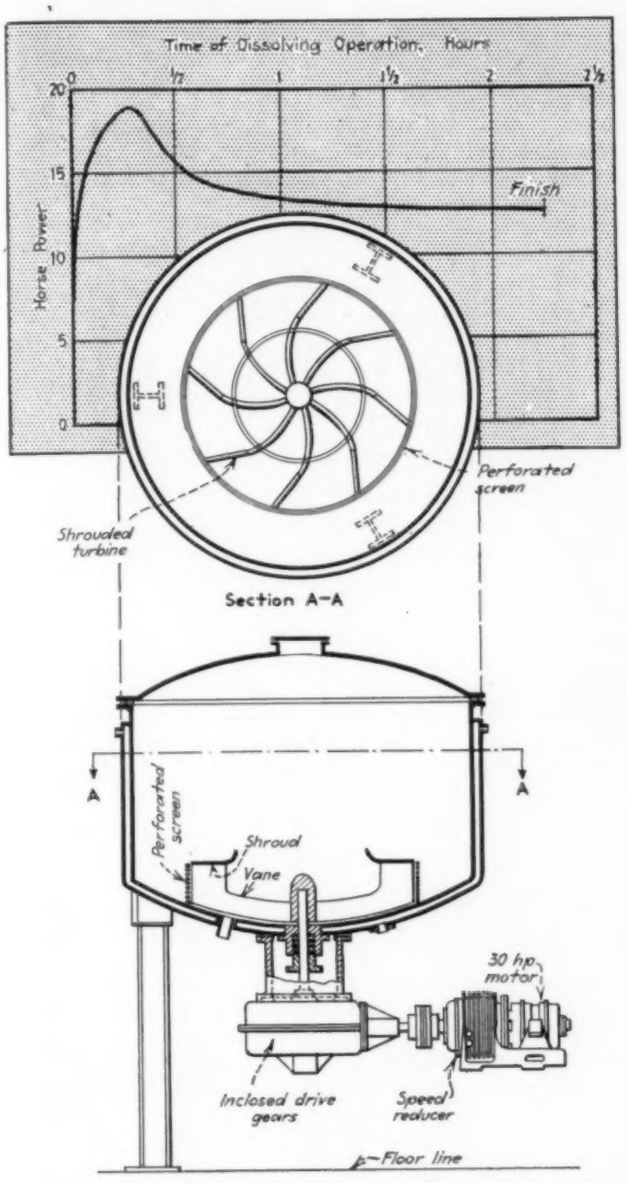


Fig. 6—Standard xanthate dissolver with shrouded turbine discharging through a screen

Fig. 7—Typical power consumption curve for xanthate dissolver producing 900 gal. of finished solution

solution. After extensive experimentation the turbine type once again proved its superiority. And yet not all turbines did this work equally well. Strangely enough, some types which were tried produced absolutely no circulation. Finally, a special spiral and angle bladed type was developed to the point where unusually rapid dissolving results were obtained, and leading acetate rayon manufacturers have since standardized upon this type. Essentially, it appears as shown in Fig. 3, equipped with two turbines. These turbines run at fairly low speed and the power consumption is low. Dissolving of cellulose acetate is accomplished in batches of 1,000 to 2,000 gal., in from 2 to 4 hours, depending upon the nature of the cellulose acetate particles and the viscosity desired. In a typical case, on a 1,000-gal. batch the power consumption varies greatly, amounting to 13 hp. at the peak and falling off to 5½ hp. at the end of the run. A typical power consumption curve appears in Fig. 4.

In all cases these mixers are made with jackets, because the solvents used in this dissolving are highly volatile and the temperature as a rule must be kept below 40 deg. F. They are also made pressure tight. Essentially a very simple design except as to turbine detail, this type has captured the favor of acetate manufacturers because it has solved their problem very effectively.

Xanthate Dissolvers

Xanthate dissolvers are used only in the dissolving of cellulose xanthate for viscose rayon or for cellulose film. This field may be limited in variety, but it is large, and consequently there are many hundreds of these machines in use.

The viscosity of the finished solutions will run from 10,000 to 60,000 centipoises, depending upon the individual preference of the rayon company. Although these viscosities are comparatively low, the problem of dissolving is more difficult in this case than with either nitrocellulose or cellulose acetate, and once again this is due to the physical form of the cellulose xanthate.

As it comes from the xanthating drum the xanthate consists of pale orange-yellow balls ranging in size from 6-in. diameter to ⅛-in. diameter, including all sizes between these extremes. These balls are somewhat rubbery in texture and in some cases can be bounced on a concrete floor, although it is possible to tear them apart with the hands. In the case of a 1,000-gal. dissolver these balls are charged in approximately one minute's time into 600 or 700 gal. of weak caustic solution in which they are to be dissolved. The effect of the caustic is to coat each ball instantly with a gelatinous layer of partially dissolved xanthate which completely prevents further action of the liquid on the interior of the lump. Consequently, unless these balls are torn apart by some mechanical means in conjunction with the dissolving, the solution will not be completed for as long as 24 hours. Every machine which has been developed for dissolving xanthate has taken this double function into consideration, and as a result the earlier imported machines have been quite complicated.

A typical European type of xanthate dissolver which was in very wide use in this country up to 1930 and is still used to a considerable extent illustrates the length to which it was considered necessary to go to obtain this solution. Fig. 5 is a sketch showing the principle of this machine. It consists in general of a semi-cylindrical trough with rather high straight sides. In this trough a mixing paddle rotates—as a rule far below the surface level of the liquid. This condition in itself makes for very poor mixing action as the liquid above the paddle is comparatively quiescent. This is one of many poor features of the design. The mixing paddles themselves are not very efficient and simply produce some churning throughout the zone in which they act but with no attempt at forcing any directional flow of the material. As an adjunct, therefore, to aid in more rapid dissolving, there is a smaller propeller-like cutter running inside a short horizontal draft tube and operated by a separate pulley which runs at a higher speed than the main shaft. This serves as a little auxiliary mixer and cutter, since the propeller is designed to draw ma-

terial through the draft tube and cut the balls up into smaller pieces. The combination of these two separate types of mixing has not been found thoroughly effective, and as a rule outside circulation is resorted to by pumping the mixture from the bottom of the dissolver back into the top. Sometimes a cutter is inserted in the pipe line.

If by going to these extremes a rapid solution could be produced with low power consumption, the use of such machines might be justified. This is not the case, however, for dissolving in these machines in most cases requires from 5 to 8 hours and the power consumption is fairly high. Furthermore, there are three individual moving parts to operate and maintain in connection with each mixer (including the circulating pump) and the size of the machines has always been fairly small, i.e., around 400 gal.

About 1927 the development of xanthate dissolvers based on the turbine or modified turbine principle was begun, and today they are considered standard equipment by most of the companies manufacturing viscose and cellulose film. In general they are all constructed as shown in Fig. 6. Essentially, all of them consist of a rather flat container in which a turbine is installed. All or part of the turbine operates within a screen which closely surrounds the impeller. When the xanthated balls are dumped into the dissolver they are caught up into the general circulation of the caustic liquid and forced through the screen, which cuts them up into very small pieces. Thus the main problem is quickly solved for there is no opportunity for surface jelling of the large lumps. Just as soon as the small pieces are produced they are rapidly dissolved.

It is possible in these newer machines to make a complete solution of xanthate in 2 to 2½ hours and, depending upon the viscosity of the solution, a 1,000-gal. machine will require from 20 to 25 hp. maximum. As appears from the typical power-time graph of Fig. 7, the maximum power consumption occurs only for a short time at the beginning of the 2-hour period. For the remainder of the run the power is usually around 70 per cent of the peak load. Some of these newer machines employ draft tubes, but these are not always necessary when the impeller and screen mechanism is properly designed. The latest type of machine, which is the one illustrated here, does not employ a draft tube and thus it is possible to run various size batches in the one machine.

The trend today in xanthate dissolvers is toward larger sizes, as some of the fears of the industry about the introduction of variables into their processes are being set at rest. Naturally, as sizes are increased, greater efficiency of production is obtained, provided none of the large batches are spoiled. It has been found in recent practice that this last point is more or less of a mental hazard, as spoilage of batches on a large scale has been next to nothing.

All xanthate dissolvers are jacketed for brine cooling and built with dished bottoms, usually with a flush valve outlet at the lowest point. In a few cases they are built with dished heads for pressure for rapid discharge. All of the more recent machines have been built with bottom drives so as to require less head room and have free space on top of the machine for charging, etc.

Although the last word on the subject of preparation of high viscosity solutions has not yet been spoken, much progress has been made in this country in the last ten years in designing efficient dissolving equipment. Whereas dissolving operations often were bottle-necks of the process in recent years, the dissolving cycle in all of the cases discussed above is now well within the time required by other dovetailing operating cycles. As a result, pressure at these vital points in the production cycle has been completely relieved.

Relating Friction Factor And Reynolds Number

A new correlation simplifies calculations pertaining to fluid flow in clean, round, straight pipe

By BENJAMIN MILLER
CITIES SERVICE CO.
NEW YORK, N. Y.

MANY INVESTIGATIONS have considered the relation between the friction factor and the Reynolds number for turbulent flow in smooth pipe. The experimental results of the investigators agree closely, but several equations have been offered to represent them. These equations are usually of the form

$$f = a + b\,Re^n \qquad (1)$$

in which f is the friction factor, Re the Reynolds number, and a, b, and n are constants. Not only have several sets of constants been offered, but f and Re have been defined in several ways, so that it is necessary to be cautious in using the equations. In accordance with the standard nomenclature of the American Institute of Chemical Engineers, and using the technical dimension system in which force, length, and time are fundamentals

$$2f = \frac{Dg\,\Delta p}{L\,\rho\,V^2} \qquad (2)$$

and

$$Re = \frac{DV\,\rho}{g\,\mu} \qquad (3)$$

The factors in these dimensionless equations may be defined as: D = diameter of pipe, ft.; g = acceleration of gravity, ft./sec.^{2}; Δp = pressure drop between inlet and outlet, lb./ft.^{2}; L = length between inlet and outlet, ft.; ρ = weight per unit volume of fluid, lb./ft.^{3}; V = space average fluid velocity, or flux divided by cross-sectional area of pipe, ft./sec.; and μ = viscosity of fluid, lb. sec./ft.^{2} (in the lb.-ft.-sec. system, but a system based on any other units of force, length and time may be used, such as kg., m. and hr.).

Both f and Re contain the velocity, so that if the problem is to estimate the velocity from the pressure drop it would seem necessary to guess at the answer and then determine whether the guess were a good one. But Drew, Koo and McAdams[3] pointed out that V could be eliminated between Equations (2) and (3):

$$Re\sqrt{2f} = \left(\frac{D^3\,\Delta p\,\rho}{gL\,\mu^2}\right)^{\frac{1}{2}} \qquad (4)$$

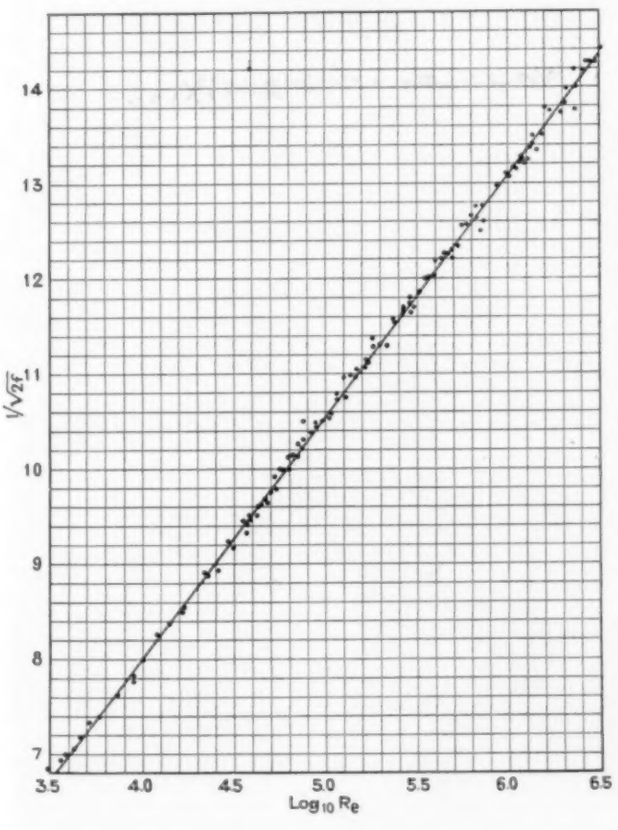
A plot of $1/\sqrt{2f}$ against $Re\sqrt{2f}$ would make possible a direct solution for V. When $1/\sqrt{2f}$ is plotted against log $(Re\sqrt{2f})$ a straight line is obtained, and this has been held to support the von Kármán[10] theory of fluid friction, though analysis which takes into account the velocity distribution and the ratio of maximum to space average velocities shows that the von Kármán theory does not agree with experiment[5]. But the straight line relationship is an experimental fact, and the equation of the straight line is

$$1/\sqrt{2f} = 2.83 \log_{10} (Re\sqrt{2f}) - 0.71 \qquad (5)$$

Drew and Genereaux[1] suggested that Equation (5) be used in preference to the several forms of Equation (1). This suggestion neglects the fact that Equation (5) cannot be used to solve directly for Δp. A direct solution for either V or Δp could be obtained from a plot of Re against $Re\sqrt{2f}$, and this is what was suggested originally by Reynolds[7]. Such a plot was presented by Johnson[3], but in such a form that the relationship did not stand out. I therefore used Equation (5) to construct a table of corresponding values of $\log_{10} Re$ and $\log_{10} (Re\sqrt{2f})$. With these values a plot was made of $\log_{10} Re$ against $\log_{10} (Re\sqrt{2f})$, and a line of very slight curvature resulted. This suggested that a plot of $1/\sqrt{2f}$ against $\log_{10} Re$ might be a straight line, and this was found to be true.

The accompanying figure is a plot of 125 experiments by Nikuradse[6]. All of the points are close to the line, whose equation is

Plot of experimental data showing agreement with Equation (6)



$$1/\sqrt{2f} = 2.54 \log_{10} Re - 2.17 \qquad (6)$$

Since Nikuradse's experimental results agree with those of other investigators in the range in which they overlap, Equation (6) may be taken as a representation of all of the data now available.

Things equal to the same thing are equal to each other, but things nearly equal to the same thing may not be so nearly equal to each other. This must be kept in mind when dealing with such approximate relationships as Equations (5) and (6). Each is a good approximation, at least as far as present experimental evidence is available, but the relationship which would be obtained by equating the right hand side of Equation (5) to the right hand side of Equation (6) would be a poor approximation. If this operation be performed, there results finally

$$Re\sqrt{2f} = A\,Re^m \qquad (7)$$

which is the index law originally proposed by Reynolds, in which A and m are constants. It is now well known that Equation (7) is valid only for a limited range, so that its use except for rough calculations is to be discouraged.

It is of interest to compare the results obtained through the use of Equation (6) with those obtained through the use of several formulas having the form of Equation (1). The formula of Lees[4], which was made to fit the experimental results of Stanton and Pannell[9], has $a = 0.0018$, $b = 0.153$, and $n = -0.35$. Since the experiments on which it was based extended only to $Re = 460{,}000$, the formula cannot be expected to hold for higher values of Re, but it does represent the experimental results below $Re = 460{,}000$ very well. The comparison of f values is

$\log_{10} Re$	=	4.0	4.5	5.0	5.5
1,000 f (Lees)	=	7.89	5.87	4.52	3.62
1,000 f (Miller)	=	7.83	5.83	4.51	3.59

To represent the results of experiments carried to higher values of Re we have the formulas of Schiller and Hermann[8], who made $a = 0.00135$, $b = 0.099$, and $n = -0.30$; Drew, Koo and McAdams who made $a = 0.0014$, $b = 0.125$, and $n = -0.32$; and Nikuradse, who made $a = 0.0008$, $b = 0.05525$, and $n = -0.237$. The comparison of f values is

$\text{Log}_{10} Re$	=	5.5	6.0	6.5
1,000 f (Schiller and Hermann)	=	3.57	2.92	2.46
1,000 f (Drew, Koo and McAdams)	=	3.57	2.90	2.44
1,000 f (Nikuradse)	=	3.55	2.89	2.39
1,000 f (Miller)	=	3.59	2.93	2.43

Equation (6) therefore agrees with previous formulas in the range in which they represent experiment; whether it can safely be used for extrapolation only further experiment can show.

Literature Cited

1. Drew and Genereaux, *Trans. Am. Inst. Chem. Eng.*, **32**, 17 (1936).
2. Drew, Koo and McAdams, *Trans. Am. Inst. Chem. Eng.*, **28**, 56 (1932).
3. Johnson, Preprinted Papers, Aeronaut. and Hydraulic Divisions, Am. Soc. Mech. Eng., Summer Meeting, 1934, page 98. George Reproduction Co., San Francisco (1934).
4. Lees, *Proc. Roy. Soc. Lond.*, (A), **91**, 46 (1915).
5. Miller, *Trans. Am. Inst. Chem. Eng.*, **33**, 474 (1937).
6. Nikuradse, *Forschungsheft*, 356 (1932).
7. Reynolds, *Phil. Trans. Roy. Soc.*, **174**, 935 (1883).
8. Schiller and Hermann, *Ing.-Arch.*, **1**, 392 (1930).
9. Stanton and Pannell, Collected Researches Nat. Phys. Lab., **11**, 295 (1914).
10. von Kármán, translated in N.A.C.A. Tech. Memo. No. 611 (1931).

Chemical Engineer's BOOKSHELF

New Technical Books

MOLECULAR MULTIPLICATION

POLYMERIZATION. By *Robert E. Burke, Howard E. Thompson, Archie J. Weith* and *Ira Williams*. A.C.S. Monograph No. 75. Published by Reinhold Publishing Co., New York City. 312 pages. Price, $7.50.

Reviewed by *L. V. Redman* and *H. P. Mills*

POLYMERIZATION is a reaction-type of broad interest. Its development and applications, which form such an important part of chemical industry, have been in certain fields of organic chemistry, but its scope is broader and there are indications that it will become of importance in other branches.

This monograph has been written to serve two purposes: (1) to present the knowledge available in a form intelligible to those whose activities may be along a totally different line, and (2) to promote research in this branch of science by furnishing a well digested survey of the progress already made and by pointing out the direction in which investigations need to be extended.

The basic principles of polymerization are clearly stated. An adequate theoretical kinetic study renders available the assistance and suggestions that may be had from this source. The present theories are discussed and the relation between theory and current industrial applications shown. The directions in which future progress will be made are suggested. Concise but sufficient citations from the literature to date of publication, well digested and critically discussed, provide a comprehensive bibliography of polymerization in a most convenient form.

Our knowledge of the relation between structure and rate of polymerization is well presented in Chapter II. Emphasis is placed on the mechanism and the structure of the starting materials and on the catalysts rather than on the structure of the polymers. The connection between unsaturation, conjugation, alkyl substitution, cyclic structures, halogen and other substituents is discussed comprehensively.

Under the subject of catalysis, a comprehensive list of substances known to polymerize, along with the catalysts, reaction conditions and products, tabulated and cross-indexed, are given in Chapter III. The mechanism of polymerization is discussed from the kinetic viewpoint in Chapter IV, and the liquid state and structure of polymers in Chapter V.

The applications of polymerization in the rubber, synthetic resin and petroleum industries constitute the last three chapters, and each may be looked upon as a satisfactory compendium of the knowledge that is available in these fields.

ELECTROCHEMISTRY OF THE NON-METALS

ALLGEMEINE UND TECHNISCHE ELEKTROCHEMIE NICHTMETALLISCHER STOFFE. By *Robert Mueller*. Published by Julius Springer, Vienna, Austria. 419 pages. Price, 30 RM.

Reviewed by *W. L. Abramowitz*

THIS VOLUME on the general and industrial electrochemistry of non-metallic substances follows the previous work (1932) of the author on the electrochemistry of the metals. Herein are included the electrolytic isolation of the metalloids and deplorization phenomena at both anode and cathode, the so-called electrolytic oxidation and reduction.

The subject matter dealt with is mostly inorganic. The electrolysis of water and brine are studied at great length; the data on the production of alkali, chlorine, and the alkali halides as hypochlorites and chlorates being particularly comprehensive. There are separate chapters on nitrogen, carbon, and sulphur compounds. The author aims to critically survey known data and to define as clearly as possible the outstanding problems, the emphasis being placed on industrial application.

Those interested in patents will discover the citations to be rather complete but unfortunately referred mostly to the German literature, as are the majority of purely scientific references. Engineers may find of value the details presented of the construction of industrial cells (particularly of the filter diaphragm and horizontal diaphragm types) as the Nelson, Krebs, I.G., Dow, Ciba, or Hooker Cells. The expedient of using smaller print for the less important material works to good advantage.

A useful addition not generally found in books on this subject is the chapter on electrodialysis and the phenomena of electrophoresis. The theory is briefly reviewed and the apparatus described. Some of the new industrial applications covered are electrolytic dehydration and drying as of peat, electro-osmotic filter presses, purification of clays, glues, sugar, water, etc., the increasingly important electrolytic depositions of rubber and the impregnation of textiles, leather, etc.

CHEMISTRY IN INDUSTRY

INDUSTRIAL CHEMISTRY. Third Edition. By *Emil R. Riegel*. Reinhold Publishing Corp., New York City. 851 pages. Price, $5.75.

BIGGER AND BETTER is this new edition of an outstanding treatise on industrial methods, equipment and materials for chemical processes. Although the number of chapters and the scope of the volume remains unchanged, 67 pages of new developments serve to bring it up to date. Worthy of special mention is the new material on petroleum, superphosphates, architectural glass, artificial silk, Neoprene, and dyes. The format and type face have not been altered; however, the readability has been somewhat increased by an increase in the number of illustrations.

The book is more than an elementary textbook on industrial chemistry; it is a handbook as well for the chemical engineer.

HANDBOOK REVISION

LANGE'S HANDBOOK OF CHEMISTRY. Second edition. Compiled and edited by Norbert A. Lange. Published by Handbook Publishers, Inc., Sandusky, Ohio. 1802 pages. Price, $6.

Reviewed by *M. E. Clark*

RARE, INDEED, is the handbook which has achieved in three short years the recognition given the first edition of this volume. Its large spacious pages, tendency to remain open at the proper place, easy legibility, and authenticity of data have won for it a place on many chemists and chemical engineers' desks.

Following the same pattern, the second edition is a revision in both quality and quantity. It contains 260 new pages in addition to many changes and modifications in the old tables. New material includes (1) 13 pages on nomenclature of organic compounds of which 9 contain diagrams of ring structure and

4 contain a glossary on systems of naming, (2) a formula index to the table of physical constants for organic compounds, (3) a whole new section of 164 pages on refractive indices, (4) 13 pages on formulas for specially denatured alcohols and their uses, and (5) 6 pages in the mathematical appendix on probability.

After two years' use of Lange's Handbook, this reviewer has been impressed by these facts: that the book contains a tremendous amount of valuable and authentic information, that the mathematical appendix is one of the best found in a handbook of this nature, that the table of conversion factors is unexcelled for usefulness, that the index is perhaps not quite as complete as it might be, and that the format of the volume is not equalled anywhere. It is recommended as a useful aid to any person working with chemistry who does not possess a copy of the first edition; however, the new edition does by no means antiquate the old.

THERMODYNAMICS IN THEORY

TEXTBOOK OF THERMODYNAMICS. By *Paul S. Epstein.* Published by John Wiley & Sons, Inc., New York City. 393 pages. Price, $5.

IT IS DIFFICULT to describe a textbook of theoretical thermodynamics to chemists and chemical engineers. So much of this subject is prerequisite for a true conception of chemical phenomena, and so little of it is actually understood and used in practice. Most of us have been taught to remember methods, applications, or processes, rather than to reason from fundamentals.

This volume, because of its logical arrangement and lucid presentation, may be of value to advanced workers in spite of (or perhaps because of) the fact that it is intended for physicists. The usual thermodynamic elements are studied; first, second and third laws, phase equilibria, perfect and degenerate gases, dilute solutions, surface energies, theory of specific heats, magnetic and electric phenomena.

BYPRODUCT COKING

MANUEL DE LA COKERIE MODERNE, VOL. I. By *M. Simonovitch.* Published by H. Vaillant-Carmanne S.A., Liege, Belgium. 750 pages. Price, 740 Belgian francs. Text in French.

WHILE this volume is based on Gluud's International Handbook of the Byproduct Coke Industry, it is not merely a French edition of the work but includes much additional information.

The subject matter of this first volume is divided into two sections. The first deals with the theoretical aspects and the history and constitution of coals, and includes much of the author's own work. It is the most comprehensive and thorough summary of the modern theory on formation and constitution of coals published to date. There is also included in this part a review of the latest Continental methods of coal testing and analyses.

The second section covers the operating and technical side of coke production. Coal washing methods are described in detail. Following this are descriptions of modern types of coke ovens with emphasis, of course, on those in use on the Continent, and especially in France. Included is a comprehensive chapter on gas producers as used for the heating of coke ovens.

The volume concludes with descriptions of types of oven machinery and coke handling equipment in current use on the Continent. The second volume probably will cover the gas and byproduct phase of the industry.

This book is a necessary complement to Gluud's *Hand-Book* in any well equipped library on byproduct coking. It is hoped the second volume will cover the gas and byproduct recovery problems of the industry in as thorough and accurate a manner.

SURVEY OF SCIENCE

THE UNIVERSE SURVEYED. By *Harold Richards.* Published by D. Van Nostrand Co., Inc., New York City. 722 pages. Price, $3.50.

THIS book is designed to give the high school graduate or first or second year college student a picture of the interrelation of the sciences, of the artificiality of departmental boundaries as compared with the fundamental unity of the natural sciences. Although the book offers an interesting story of the broad realms of physics, chemistry, geology and astronomy, it contains a rather large dose of rudiments, principles, details, new words and historical facts that the reader may find a bit difficult to correlate in spite of the fact that the author has tried hard to keep his aim in mind. Professor Richards writes with an appealing vitality, and he has added to the educational value and enjoyment of the book by appending 850 true and false review statements that carry all the fascinatioin of a scientific "Ask Me Another."

BASIC INDUSTRIAL MARKETS IN THE U. S.—PULP AND PAPER INDUSTRY. Market Research Series No. 14.4, Dept. of Commerce, Bureau of Foreign and Domestic Commerce. Price, 10 cents.

THE IMPORTANCE of the pulp and paper industry as a market for equipment and chemicals is shown in a comprehensive study just published. The normal value of the production of pulp and paper is approximately $700,000,000 a year. The industry annually purchases several hundred million dollars worth of equipment and is therefore one of the greatest single industrial markets in the country.

The study contains 77 pages of text and statistical data and is illustrated with 12 maps which geographically show the location and density of each major group of the two branches of the industry. Data is included on production capacity and machinery installations per county.

DOES "BIG BUSINESS" PAY?

HOW PROFITABLE IS BIG BUSINESS? Prepared under the direction of the Corporation Survey Committee of the Twentieth Century Fund, New York City, Alfred L. Bernheim, editor. 201 pages. Price, $2.

SECOND in the series of factual studies of so-called "big business" (See *Chem. & Met.*, March 1937, p. 154), this volume seeks an answer to the question: Is there a most profitable size for American industry? Unfortunately, no simple answer is possible. In general, bigness seemed to act as a stabilizing factor. Large corporations made profits at lower rates than small ones while those that lost money lost at lower rates than did the smaller corporation. In other words, profit or loss varied within a narrower range for big business.

Of forty large chemical companies studied, six were in the "giant class", with assets $50,000,000 and over, and 24 had assets between $10,000,000 and $50,000,000. By applying various ratios to measure profitableness some significant variations are revealed among the different industrial groups. Students of the fiscal affairs of industry will find this an interesting and helpful volume.

NEW MINERAL DATA

MINERALS YEAR BOOK, 1937. Compiled by the Bureau of Mines, U. S. Department of the Interior. Available from U. S. Government Printing Office, Washington, D. C. 1502 pages. Price, $2.25.

THIS REVIEW of the minerals industries for 1936 shows continued progress in recovery, particularly in durable finished goods such as railroad equipment and heavy machinery. Typical was the increase of iron and steel operations from 51 per cent capacity in January, 1936, to 78 per cent in December. The scope and arrangement of statistics in this volume continue the same as in previous ones.

KUNSTSTOFF-WEGMEISER. By *Gg. Kranzlein* and *R. Lepsius*. Published by Verlag Chemie G.m.b.H. Berlin. 140 pages. Price, 1.50 RM.

THIS IS a valuable little booklet on the plastic materials of Germany. Such phases of the subject as raw materials, molding equipment and processing are briefly covered. A bibliography of the literature, a list of the magazines dealing with plastics, a list of producers and a tabulation of the German products are included. The alphabetical list of plastic products also gives information dealing with the nature of the material and the manufacturer's name.

EFFECT OF IMPURITIES IN COPPER. By *S. L. Archbutt* and *W. E. Prytherch*. Published by the British Non-Ferrous Metals Research Association, London. 134 pages. Price, 12s. 6d.

AN EXTENSIVE investigation of the effects of the common metallic and non-metallic elements both alone and in combination as impurities in copper has been made by the British National Physical Laboratory. The results of the investigation are summarized and correlated in this monograph. Much physical data in convenient tabular or graphical form indicates the effects of different amounts of impurities on such properties as electrical conductivity, suitability for hot and cold rolling, tensile strength, elongation, hardness, impact resistance, fatigue limit and density.

The results obtained from the investigation have made it possible to predict the maximum content of impurities which may be permitted in copper for various purposes without detrimental effect, providing the copper is prepared under standardized conditions. Additional investigation of the segregration of impurities in large production-scale ingots indicated that results of the laboratory work may be directly applied to works practice if the proper relevant factors are taken into account. A number of good photomicrographs help show the changes in microstructure of the metal caused by the various impurities.

CONVENTION PAPERS AND PROCEEDINGS OF THE TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY, 1936–37. Published by the Association, 122 East 42nd St., New York City. 445 pages.

IN THIS VOLUME, Series XX of the Technical Association Papers, are included the proceedings of the annual meeting at New York City in February, 1937, the proceedings of the international meeting held in Montreal, Canada, in August, 1936, and 96 technical papers and official committee reports submitted during the past year.

MAGNESIUM AND ITS ALLOYS. Published by the Metallurgy Research Board of the Department of Scientific and Industrial Research, Great Britain. Available from His Majesty's Stationery Office, London, England. Price, 2s. 6d. net.

MUCH scattered information on the use of manesium alloys as an engineering material of construction has been published in recent years, and it is the purpose of this monograph to summarize the most significant of this material in a single volume. The book is divided into the following sections, each emphasizing the practical aspects of the magnesium alloys as a new engineering material: sources and production, corrosion, melting and casting, the commercial alloys of magnesium, magnesium alloys at high temperatures, and the constitution of magnesium alloys.

GOVERNMENT PUBLICATIONS

Documents are available at prices indicated from Superintendent of Documents, Government Printing Office, Washington, D. C. Send cash or money order; stamps and personal checks not accepted. When no price is indicated pamphlet is free and should be ordered from bureau responsible for issue.

Asbestos, by Oliver Bowles. Bureau of Mines Bulletin 403; 15 cents. Report covering the essential features of the asbestos industry.

Production of Explosives in the United States During the Calendar Year 1936, by W. W. Adams and V. E. Wrenn. Bureau of Mines Report of Investigations 3350; mimeographed.

Dust Hazards and Their Control in Mining, by D. Harrington. Bureau of Mines Information Circular 6954; mimeographed.

List of Respiratory Protective Devices Approved by the U. S. Bureau of Mines, by H. H. Schrenk. Bureau of Mines Information Circular 6952; mimeographed.

Review of Literature on Effects of Breathing Dusts With Special Reference to Silicosis, by D. Harrington and Sara J. Davenport. Bureau of Mines Bulletin 400; 25 cents.

Procedure for Testing Supplied-Air Respirators for Permissibility. Bureau of Mines Schedule 19A; 5 cents.

Applied Methods and Equipment for Reducing Evaporation Losses of Petroleum and Gasoline, by Ludwig Schmidt. Bureau of Mines Bulletin 379; 20 cents.

Relative Value of Gypsum and Anhydrite as Additions to Portland Cement, by Paul S. Roller and Murray Halwer. Bureau of Mines Technical Paper 578; 5 cents.

The Preparation of Illustrations for Reports of the United States Geological Survey, by John L. Ridgway. U. S. Geological Survey unnumbered pamphlet; 25 cents.

Sodium Sulphate. Tariff Commission Report No. 124, Second Series; 10 cents. A survey of the U. S. production, consumption, and foreign trade with particular reference to factors essential to tariff consideration.

Federal Alcohol Administration Act, as in Effect on May 15, 1937. Federal Alcohol Administration unnumbered pamphlet; 5 cents.

Educational Qualifications in the Engineering Profession. Bureau of Labor Statistics Serial No. R. 400.

Income and Earnings in the Engineering Profession, 1929 to 1934. Bureau of Labor Statistics Serial No. R. 588.

Customs Regulations of the United States, 1937. Published in Federal Register, August 25, 26 and 27, three issues; 5 cents each.

Standard Samples Issued or in Preparation by the National Bureau of Standards. Supplement to Bureau of Standards Circular 398.

Evaluation of Motion-Picture Film for Permanent Records, by John R. Hill and Charles G. Weber. Bureau of Standards Miscellaneous Publication 158; 5 cents.

Permeability of Membranes to Water Vapor With Special Reference to Packaging Materials, by Frederick T. Carson. Bureau of Standards Miscellaneous Publication 127; 5 cents.

The Arsenates of Manganese as Insecticides (a review of the literature), by F. E. Dearborn. Bureau of Entomology and Plant Quarantine, E-408; mimeographed.

Vitamin Content of Foods, by Esther P. Daniel and Hazel E. Munsell. Department of Agriculture Miscellaneous Publication 275; 15 cents.

Apparatus for Dusting Individual Plants, by J. P. Vinzant. Bureau of Entomology and Plant Quarantine ET 105; mimeographed.

Some Common Disinfectants, by M. Dorset. Department of Agriculture, Farmers' Bulletin 926; 5 cents.

Second Report of the Special Advisory Committee on Water Pollution and Summary of State Legislation Affecting Water Pollution. National Resources Committee, unnumbered pamphlet.

Shingles; Mineral-Surfaced Asphalt. Bureau of Standards, Technical Information on Building Materials 51; mimeographed.

Federal Specifications. New or revised specifications of the Federal Specifications Board on: Paper, general specifications, UU-P-31a; Fire-extinguishing-liquid, carbon-tetrachloride base, 0-F-380; Wax, floor, water-emulsion, P-W-151; Tableware, corrosion-resisting steel, RR-T-41; 5 cents each.

The Interterritorial Freight Rate Problem of the United States. House Document 264, 75th Congress, 1st Session; 20 cents. A survey conducted by the Board of Directors of the Tennessee Valley Authority.

Annotated List of the Insects and Mites Associated With Stored Grain and Cereal Products, and of Their Arthropod Parasites and Predators, by R. T. Cotton and N. E. Good. Department of Agriculture Miscellaneous Publication 258; 10 cents.

Flour-Mill Insects and Their Control, by G. A. Dean and others. Department of Agriculture Circular 390; 5 cents.

The Balance of International Payments of the United States in 1936. Bureau of Foreign and Domestic Commerce unnumbered pamphlet; 15 cents.

List of Periodicals Currently Received in the Library of the United States Department of Agriculture. Department of Agriculture Miscellaneous Publication 245.

Federal Old-Age Benefits under Title II of the Social Security Act. Social Security Board Regulations No. 2; 10 cents.

Progress Report 4 on Investigation of Detachable Rock Drill Bits, by McHenry Mosier. Bureau of Mines Information Circular 6951; mimeographed.

Effect of City Water and Sewerage Facilities on the Market for Air Conditioning Equipment. Bureau of Foreign and Domestic Commerce, Market Research Series No. 16, mimeographed; 10 cents.

Readers' VIEWS and COMMENTS

Opening Light Drums

To the Editor of Chem. & Met.:

Sir:—There have been published in your magazine several inquiries for a tool for opening bleach cans.

At the Edgewood Arsenal during the World War, it was necessary to open as much as 400,000 lb. of bleach in one day in the course of manufacturing chloropicrin. Bleach operators told us to cut the heads out of the cans with an axe, but this proved to be very slow indeed. We developed a can opener about 2½ ft. long, which was in every way proportional to the ordinary household can opener in its dimensions. The knife was about 8 in. long and came out to a sharp point. The distance from the knife to the lever was about 2 in.

In opening the cans originally, we tried to open the top much as one does a can in the kitchen. It was found, however, that if the tool were "jabbed" into the can to the left of the seam in the barrel of the drum, in a few seconds it was possible to work around to the other side of the seam. No effort should be made to cut off the seam, but on bending the head of the drum back sharply the lid breaks off usually with one or two bends. This knife worked so satisfactorily, was so simple and easy to make, that it seems to me every user of bleach should have one. Any blacksmith can make one very easily.

O. R. SWEENEY
Head of Chemical Engineering Dept.
Iowa State College

HAMMER AND FILE METHOD

To the Editor of Chem. & Met.:

Sir:—May I suggest a simple method for cutting out drum heads that I have found to be efficient and not hazardous to the operator.

Tools required: A hammer and one 14-in. flat bastard file with wooden handle. Method: Hold the file in the left hand at an angle of about 45 deg. so that the end of the narrow side of the file rests on the edge of the drum head. Hit the file with the hammer so that the force of the blow will drive the file through the drum head and make a cut about an inch long close to the rim of the drum. Using the file and hammer in this manner follow the cut around the rim of the drum.

With a little experience the operator will be able to cut out a drum head in a minute or two, making a clean smooth opening. The edge of the file that is struck by the hammer can be annealed so that it will not be brittle.

PAUL J. LALONDE
The Shelton Tack Co.
Shelton, Conn.

BOOKSHELF

(*Continued from page 620*)

ELOQUENT INTERPRETERS OF SCIENCE

THE ADVANCING FRONT OF SCIENCE. By *George W. Gray.* Published by Whittlesey House, McGraw-Hill Book Co., Inc., New York City. 364 pages. Price, $3.

EVERYDAY SCIENCE. By *A. W. Haslett.* Published by Alfred A. Knopf, New York City. 305 pages. Price, $2.75.

Reviewed by *S. D. Kirkpatrick*

WHEN ASKED to write an article on "Why I Left Chemistry," one of my editorial colleagues protested that he had not deserted his science but had purposely chosen to serve as one of its interpreters. He argued convincingly, it seemed to me, for the necessity of translating the work of his chemical brothers into language that made it interesting and useful to the world. Lately, we have heard a lot about this need for interpretation. In his preface to one of these books, George W. Gray, an American author and former newspaper reporter, writes:

"One of the imperative tasks of our day is to interpret the purposes, methods and results of science in such wise that the greatest adventure of the human spirit may be 'understanded of the people.' Science needs to be made use of, but understanding of it must precede complete utilization."

In the second book, A. W. Haslett, the science correspondent of the late *London Morning Post,* remarks of the fact that "so far as the general public is concerned, there is inevitably a lack of solid background in all discussion of the impact of science on social life." He proposes "to do something to remove this difficulty. Information, however inadequate, must precede opinion."

In each instance these are "second books"—sequels to previously accepted discussions—Gray's "New World Picture" and Haslett's "Unsolved Problems of Science."

Each treats in general of the same subject, in about the same number of pages and with the same objective of scientific interpretation. Yet the similarity ends there. Gray's book is science itself, translated with the enthusiasm of the scientist into words and thoughts that make that enthusiasm infectious as well as understandable. It is of deep human interest, not because it applies science to man's needs but rather because of its intensely human approach to all phases of scientific progress. Whether listening to "the cosmic bombardment" or digging "deeper into the atom" or finding out "where life begins" or studying the "chemistry of thinking"—there is no letdown of interest and enthusiasm. Much of this is due to the masterly style and technique of the man whom *Time* has recently called "one of the ablest popularizers of science writing in English." This same magazine classes Gray's book with Jaffe's "Outposts of Science" as "the two best books recently published in the U. S. on contemporary research."

Less "literary," perhaps more practical, but a bit more prosaic is the work of England's interpreter of science. Haslett has chosen to contrast new ways with old in showing what has been done to create new sources of heat and energy, provide food and shelter, detect crime, stimulate agriculture, provide for the necessities and comforts of life. He does it well, with more solid facts than academic fancies. Yet when contrasted with the other book it seems to lack the essential qualification most of us want in our interpreters—eloquence and enthusiasm.

Your Plant NOTEBOOK

TREATMENT OF CHEMICAL BURNS

Below is presented an abstract from the National Safety Council's recent copyrighted pamphlet, Industrial Safety Series No. Chem. 3, on "Chemical Burns, Their Nature and Treatment." The subject is so important that the complete pamphlet should be available in all plants where the possibility of chemical burns exists. The abstract, however, presents the highlights of the discussion.

CHEMICAL BURNS are often thought to be similar to heat burns, but this is true only in that both may cause destruction of body tissue. The object causing a heat burn may cool or the person may withdraw from the object, and destruction of the tissues ceases. When contact is made with a chemical substance, however, the contact continues as long as the agent is present in sufficient concentration to destroy the tissue. Absorption must also be considered in treating chemical injuries, as this may cause illness or death.

In a third degree burn the covering of the blisters is destroyed and considerable fluid may leave the body; in fact, from a burn of any considerable extent, several pints of fluid may be lost. The loss of this circulating fluid may have the same result as a severe hemorrhage and unless it is controlled (or replaced with normal saline or glucose solution), death of the patient may result.

Absorption of the products of tissue destruction may become manifest on the third or fourth day following the injury. It has often happened that, following a severe burn, a patient will be quite comfortable and appear to be recovering satisfactorily. However, at the end of a few days he may become slightly dull and listless and then slowly drift into unconsciousness with death following as the final possibility. Therefore, the treatment of burns should have a triple objective: (a) to relieve pain immediately; (b) to control the loss of fluid; (c) to prevent the absorption of poisonous substances which may kill the patient several days after the injury has occurred.

If a patient's clothing becomes soaked with corrosive fluids, burning will continue until the clothing is removed. Clothing should be removed immediately, but at the same time every effort should be made to keep the injured person warm. When the burned area is exposed, the acid or alkali which remains should be removed by flushing copiously but gently with large quantities of water—warm if possible. Shock will be lessened if the water is warm, but speed is of greater importance and, if possible, a stream of running water should be directed onto the burned area so that all the chemical may be washed away. The burned area may then be treated as any heat burn and covered with any suitable protection, preferably a water soluble jelly.

Persons giving first aid often make the mistake of first applying an antidote. It is of advantage to apply some neutralizing agent, but this treatment is not nearly as important as proper flushing with water. Many antidotes will neutralize the chemical that lies on the skin only and not penetrate to a sufficient depth to prevent corrosion of the deeper structures. Also, when burns are treated by neutralization heat may be generated by the chemical action. Large amounts of water tend to carry off heat.

According to some authorities, one of the most effective agents now known to combat burns is freshly made tannic acid solution. (This apparently applies mostly to third degree burns, as other authorities have claimed that where the epidermis or outer skin is not destroyed, tannic acid may interfere with its activity.) Here we have a preparation that controls pain satisfactorily, contracts the burned tissues, thus preserving in them their normal fluids which might otherwise be lost, and fixes on the surface the products of tissue destruction so that they cannot be absorbed into the blood stream. Another treatment now being used by many doctors is gentian violet in the form of a jelly for first, second or third degree burns. In all known cases the results have been satisfactory. No scars have remained, and the course of the patient has been relatively free from fever.

Shock usually occurs in some degree after all injuries. When shock conditions are observed, a doctor should be summoned immediately. The person should be placed in a comfortable position with his head low. The person should be wrapped in warm blankets, and, if conscious, may be given a teaspoonful of aromatic spirits of ammonia in half a glass of water, or hot coffee, hot tea or hot water. If the person is unconscious use aromatic spirits of ammonia poured on a cloth under his nose.

Chemical burns to the eye differ from those to the skin, as the eye always presents a moist surface. While the eye has no protecting surface, the outpouring of tears tends to dilute and remove any material. The importance of immediate first aid should be stressed. The mechanical removal of the chemical is very important. This can best be accomplished by careful washing, even in the case of substances which are not readily soluble in water. Do not pour water directly on the eyeball.

Experiments have led to the conclusion that treatment by neutralization increases the damage to the eye and, therefore, thorough washing with water should be encouraged as a first aid measure. This is true regardless of the concentration of the chemical. Following the washing there should be an early use of bland oil or antiseptic ointment.

Shower Baths

Since it has been proved conclusively that washing all acid or alkali burns with a generous supply of water is the best method of treatment immediately after the burn, it is essential that an ample supply of water be made available near all acid tank filling stations and other places where a workman is likely to encounter corrosive chemicals. A most effective method is a shower made up of 1¼ or 1½ in. pipe equipped with a quick opening valve, giving a strong impact of a 1¼ in. stream of water which will penetrate the worker's clothing more rapidly than water from a tap. This type is used quite extensively in chemical plants. A satisfactory type of shower bath is one with a quick opening valve which operates by merely stepping on a platform, the workman being deluged with water immediately.

In many plants where operations are carried on at considerable distance from a shower bath it is advisable to have tubs or barrels of water nearby into which workers can jump in an emergency. Many serious burns have been prevented and lives saved by such first aid measures.

Specific Treatments

Exposure to different chemical agents produces different effects. In addition to the general treatment previously described, exposure to any particular agent may require certain specific first aid treatment. The following paragraphs contain brief descriptions of some im-

portant corrosive agents and suggestions for further first aid treatment—remembering always that flushing the burned area with water until a glow returns to the skin is the important first treatment and that a doctor should be brought upon the scene as soon as possible.

Acetic Acid—Bathe freely with water and apply a saturated solution of bicarbonate of soda.

Alkalis—When alkalis come in contact with the skin, there is reported to be an inactive period between the time of application and the actual burn. However, this inactive period probably will not be more than three minutes, and no time should be lost before washing. Immediate first aid is essential to prevent serious burns.

Ammonia—Bathe freely with water and then apply a 2 per cent solution of acetic acid.

Carbolic Acid—Wash at once with water and then with grain alcohol or sodium sulphate.

Caustic Potash—Bathe freely with water and then apply a 2 per cent solution of acetic acid.

Caustic Soda—Bathe freely with water and then apply a 2 per cent solution of acetic acid.

Chromium—Workers in dyestuffs, photo engraving, electroplating, steel manufacture and leather tanning are subject to chromium burns. Chronic acid, the usual source of such injuries, causes what is known in industry as the "chromehole." There is also danger of absorption which may result fatally. For additional information on this subject see the National Safety Council's Health Practices Pamphlet No. 1, "Chromium."

While chromium burns should be given a thorough washing with water, satisfactory results may also be secured from the application of a few drops of ammonium polysulphide, thus reducing the acid to a milder irritant.

Cyanide—Cyanide burns are relatively frequent because cyanides are used in so many industrial operations. The action of cyanide on the skin, while similar to that of alkalis, usually causes an "eczema-like" eruption. Serious burns may be caused by the splashing of fused cyanide, and as there is danger of absorption which may cause death, prompt treatment is necessary. Immediate removal of the burned flesh by a doctor is highly desirable but where this is impracticable, some steps should be taken to reduce the rate and amount of absorption, as by dropping either 20 per cent potassium permanganate solution or ammonium polysulphide solution on the burn.

Hydrochloric Acid—Bathe freely with water and apply a saturated solution of bicarbonate of soda.

Hydrocyanic Acid—Wash with water and then immediately drop on the burn either ammonium polysulphide or a solution of potassium permanganate.

Hydrofluoric Acid—Hydrofluoric acid is a colorless liquid and a violent corrosive. Skin burns show a tendency to suppurate and heal very slowly. Apply a 5 per cent solution of ammonium carbonate or powdered sodium bicarbonate to the burn. Boric acid is also recommended.

Lewisite—Lewisite is an oily liquid with an odor like that of geranium. Its burning action on the skin is similar to that of mustard gas except that it is much more rapid. Demarcation of the affected area becomes plain by the end of 15 minutes. The treatment is similar to that for mustard, and it must be prompt. Clothing should be removed and the entire body washed with soap and water. For skin injuries from liquid lewisite apply a 5 per cent aqueous solution of sodium hydroxide followed by a 95 per cent solution of alcohol. Vapor burns are best treated with ferric hydrate paste and then covered with first aid dressings.

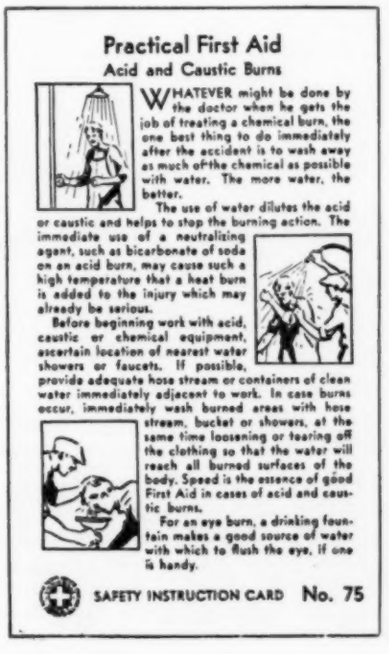
Lime—These injuries usually occur during the slaking process, and as a considerable amount of heat is liberated and the combination of lime with moisture is rapid, both heat and chemical burns may result. Lime burns of the eye may prove especially serious. A satisfactory method of treating lime burns is to wash thoroughly with water. Should further trouble be experienced with eye cases, the deposit of calcium salts may be dissolved from the eye by a neutral solution of ammonium tartrate.

Metallic Salts—Metallic salts which are frequent causes of burns are silver nitrate, copper sulphate and zinc chloride. Burns from zinc chloride, which is used in the preservation of wood, are characterized by ulcers and loose dead tissue. The application of sodium bicarbonate solution is considered an effective treatment for burns from metallic salts.

Methyldifluorarsine and Methyldichlorarsine—Exposure to either vapors or liquid causes skin burns of varying degrees. Contaminated clothing should be removed immediately and the skin washed with soap and water. Sodium hydroxide (5 per cent solution) should then be applied. After 3 to 5 minutes the sodium hydroxide should be removed with soap and water. Bathe eyes with a three per cent solution of boric acid and place compresses.

Mustard Gas—Mustard is generally considered a lung and eye irritant in gaseous form, but it will burn the skin surface, especially moist areas. Burning is followed by discoloration and blistering. Mustard gas is particularly dangerous because of its destruction of the mucous membrane of the respiratory tract, often causing pneumonia. In case of contact wash the affected areas at once. Mustard will penetrate the skin very rapidly and unless washed off immediately, serious burns may result. The skin should be washed continuously with soap and running water. If possible, apply carbon tetrachloride saturated with chlorine or wash with sodium hypochlorite solution.

Miniature of one of several National Safety Council instruction cards on chemical burns



If sodium hypochlorite is not available, a solution of calcium hypochlorite may be used.

Application of solvents such as benzene, chloroform, ether, carbon tetrachloride, gasoline, kerosene or alcohol are of value, followed by drying, washing with hot, soapy water, and hourly treatments with sodium hypochlorite solution. The eyes, nose and throat may be cleaned with saturated boric acid solution, a normal salt solution (1 level teaspoonful to a pint of water) or a one per cent sodium bicarbonate solution.

Nitric Acid—General advice is to bathe freely with water and then apply a saturated solution of bicarbonate of soda. Nitric acid has been stated to burn very deeply and, therefore, requires much neutralization.

Oxalic Acid—Bathe freely with water and apply a saturated solution of bicarbonate of soda.

Phenol—Carbolic acid, or phenol, cannot be readily washed off the skin. It is rapidly absorbed through the skin, and in serious cases death may occur quickly because of its poisonous qualities. Burns may be treated by the liberal application of alcohol, or alcohol combined with ferric chloride in which it is very soluble, or with sodium sulphate with which phenol combines to form sodium sulphocarbolate, which is non-toxic. Water remains an excellent medium for washing phenol from the eyes.

Phosphorus—When white phosphorus comes in contact with the skin, it adheres and ignites, thus causing a heat burn. On immersion in water the flame is extinguished, but it reignites if withdrawn from the water. In treating such burns a 1 per cent solution of copper sulphate may be used for three minutes. This combines with phosphorus, forming copper phosphide which is inert. The burn should then be treated the same as a heat burn.

Picric Acid—Bathe freely with water and apply a saturated solution of bicarbonate of soda.

Soda Ash—Bathe freely with water and then apply a 2 per cent solution of acetic acid.

Sodium—When metallic sodium splashes upon the skin of the worker, it adheres and extracts water from the skin, and the burning continues until no more water is available. This action alone causes severe burns, and the highly concentrated sodium hydroxide which is formed continues the action set up by the sodium. Whenever possible apply a coating of any paraffine oil; this breaks the contact of the sodium with the water of the skin and thus stops the burning. The sodium must then be removed mechanically and the wound carefully and thoroughly washed with water.

Sulphuric Acid—Bathe freely with water and apply a saturated solution of bicarbonate of soda.

Tar—The danger from tar burns is not only that which arises from the destruction of tissue, but unless the tar is completely removed, certain poisons of the phenol group may be absorbed into the blood stream, and if the quantity is sufficiently great, fatal damage may be inflicted on the kidneys. Persons have died because of kidney damage from tar burns that covered but a few square inches. A satisfactory method of removing tar from the skin is to use trichlorethylene or other tar solvents which, however, may be toxic and should be used with discretion. Trichlorethylene may be applied with a specially constructed spray or with a swab. A burn of any extent is a case for a doctor.

Process Equipment NEWS

Machinery, Materials and Products

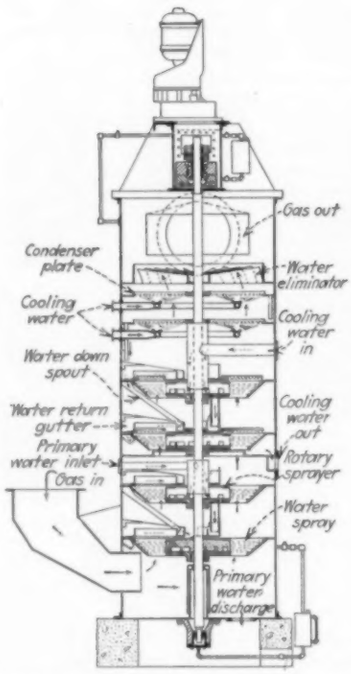
Welded Ammonia Tank Car

PERMISSION has been granted recently by the Interstate Commerce Commission to E. I. du Pont de Nemours & Co. to construct for experimental purposes 25 fusion welded steel tank cars for anhydrous ammonia. Permission to fusion weld tank cars has so far been granted only for experimental use but excellent results are said to have been attained in cars already fabricated by this means.

Gas Scrubber

LOW POWER CONSUMPTION, water requirements and pressure loss, combined with extremely high scrubbing efficiency, are claimed for a new design of gas scrubber recently announced by the Peabody Engineering Corp., 580 Fifth Ave., New York City. In addition to its use as a scrubber the new machine is said also to be capable of excellent work as an absorber or reaction chamber. The scrubber consists of a vertical cylinder within which is a rotating shaft carrying a number of centrifugal spraying devices with perforated rims. Water sprayed from each of these elements strikes a conical apron baffle attached to the shell, flowing up the apron and on to a horizontal ledge from which it is diverted to return gutters conveying it back to the same sprayer, with much of the initial energy retained. The raw gas is then introduced tangentially at the bottom of the scrubber, passing upward in a straight line to the several sprays, finally passing through a series of condenser plates providing for impingement, and through a set of eliminator vanes said to insure a dry gas at the outlet.

In operation, the scrubber is supplied with warm water for humidifying the gas in the lower stages, and with cool water for controlling the condensation of vapor on the dust particles in the upper stages. It is claimed that through this feature of controlled condensation, any desired degree of gas cleanliness can be attained. Larger particles are removed mechanically, while the smallest particles of suspended matter are weighted down with condensed water until they are capable of removal. This design is said to insure economical utilization of water, and of power, on account of the considerable recovered energy of the sprayed water.



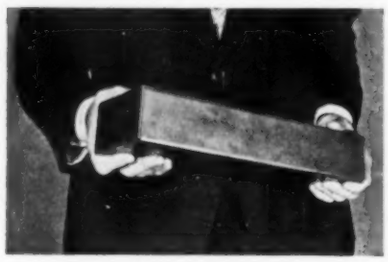
Cross section of new spray type scrubber

The vertical shaft for the rotating sprayer elements is supported on oil-immersed, self-aligning, heavy-duty bearings connected to a standard design of motor reducer. No stuffing boxes are required and with all cleaning elements subject to direct contact with the scrubbing liquid, no possibility of plugging with deposited solids is said to exist.

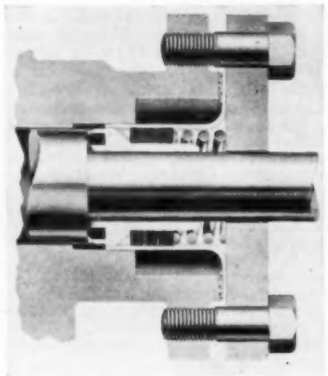
Steel-Encased Brick

AN IMPROVED FORM of steel-encased magnesite refractory brick is now being supplied by the Harbison-Walker Refractories Co., Pittsburgh, Pa., under the name of H-W Improved Metalkase. The brick is intended for industrial furnace applications where operating conditions are unusually severe. The brick is of chemically bonded magnesite, said to be highly refractory and resistant to corrosive basic slags. It is encased on three sides in a mild steel jacket so that when laid as headers, such brick are completely steel jacketed except at the ends. At furnace temperature, the ends of the steel jacket at the heated face oxidize and melt, fusing with the brick itself to form a monolithic surface. These brick are recommended for use in cement and dolomite kilns, and in other high temperature kilns where physical strength and resistance to corrosive basic slags are essential.

This same company has announced recent improvement in the refractoriness and working properties of its high temperature bonding mortar, Harwaco Bond. This diaspore-base bonding mortar is stated to have a pyrometric cone equivalent of 32, or 3,092 deg. F.



New steel-encased brick



Cross section of new rotating shaft seal

Rotating Shaft Seal

FOR ELIMINATING leakage of gases and liquids around rotating or oscillating shafts of compressors and pumps, the Syntron Co., Homer City, Pa., has developed a new shaft seal which has for its main sealing and wearing surfaces an anti-friction self-lubricating compound insert in high quality bearing metal. The sealing head of bearing metal with its anti-friction insert is held firmly against the shoulder on the rotating shaft by means of strong spring pressure which also bears on the packing ring sealing the bearing head to the housing. The new seal has been proven effective, according to

the manufacturers, on worn and scored shafts as well as on new ones. Elimination of leakage over a long period of time without adjustments, self-seating action, self-lubrication and self-centering are the major claims.

Taper-Tube Flowmeter

IMPROVEMENTS in the construction of flowmeters of the taper-tube type have been announced by Fischer & Porter Co., 110 West Penn St., Germantown, Philadelphia, Pa. In this company's recently introduced line of Rotameter flowmeters, an important feature is the use of completely interchangeable tapered glass tubes which does away with the necessity for individual adjustment of each meter and permits ready replacement in case of breakage. Another improvement is the use of colored pigment which is fused into the etched flow rate scales. The company is prepared to supply flowmeters in a variety of sizes and designs, employing both guided and non-guided floats, and those compensated for pulsating flow. It is also manufacturing flowmeters with remote electric recording and indicating as well as those equipped for automatic flow control.

Improved Water Stills

TWO NEW improvements in the large industrial water stills manufactured by the Barnstead Still & Sterilizer Co., Lanesville Terrace, Forest Hills, Mass., have been announced. Cleaning of the evaporator is facilitated through the use of a readily opened evaporator trap door on which the steam heated coil is mounted. The second new feature is a quick demountable condenser which can be taken down for cleaning by any average plant worker. Reduced water costs and efficient condensation at all times are thus said to be assured. These new features are available on all water stills of 50 gal. per hour and higher capacity made by this company.

Rotary Pumps

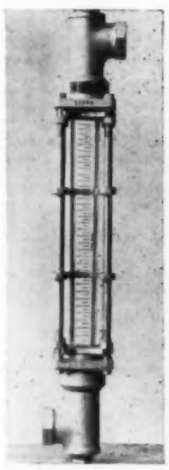
PRACTICALLY any liquid which will flow through a pipe can be handled in the new Moino pump recently introduced in the United States by Robbins & Myers, Inc., of Springfield, Ohio. This pump, an adaptation of the pump developed in France by R. Moineau and previously used also in England, is a rotary positive pump without valves, having but one moving assembly. The pump is said to combine the advantages of both piston and centrifugal types in that it is self-priming and will operate under high pressures, while the flow is uniform and causes minimum turbulence of the liquid.

The stator is in the form of a cylindrical lining which has the internal form of a double threaded helix. The rotor, on the other hand, is in the form of a single threaded helix such that it meshes with and turns in the helix of the stator. Thus it effects a positive endwise displacement of the liquid in the remaining space of the open helix. The result is that the rotor maintains a sealed contact throughout its length and the pump is valveless. In single-stage models, efficient maximum delivery head is in the region of 150-200 ft. of water. By combining two or more stators and rotors in the line of flow, 500-800 ft. of discharge head can be obtained.

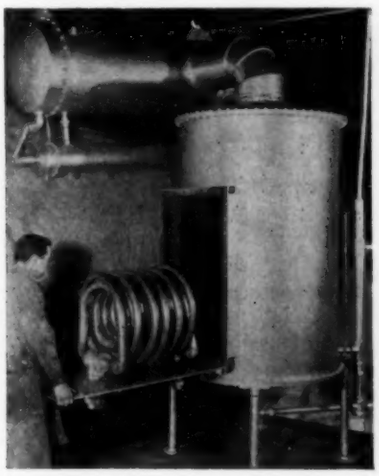
Rubber is used in the stator or stationary pumping element owing to its resistance to erosion. For special applications, however, acid and oil resistant synthetic rubbers are used. Bronze or special steels are ordinarily used for the rotor. A double universal drive link terminating at each end with a universal joint consisting of a ball and pin drive, is used to transmit motion from the drive shaft to the eccentric rolling rotor. Special steels are generally used for these parts.

The pump is recommended by its manufacturers for a wide variety of services and can be constructed of materials suited to almost any condition.

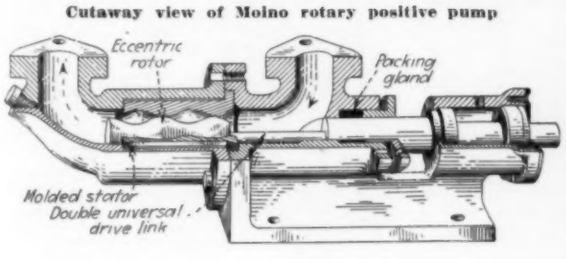
Taper-tube flowmeter



Improved water still showing ready accessibility of interior



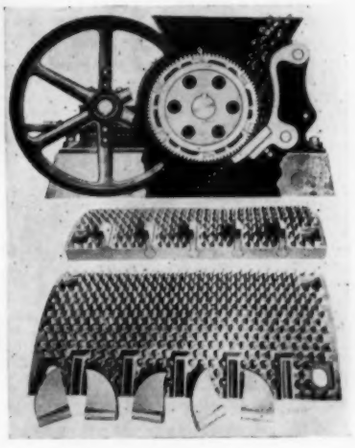
Cutaway view of Moino rotary positive pump



Single-Roll Crusher

DESIGNED to minimize the production of fines and oversize, a new single-roll crusher has recently been developed by the Jeffrey Mfg. Co., Columbus, Ohio. This crusher is intended primarily for coal but is also suggested for use with other materials of similar characteristics. Its renewable segments carry thin, sharp pyramid and spear-point teeth which, through a piercing rather than a mashing action, are stated to minimize degradation. A new breaker plate design is said to increase capacity. Earlier designs of Jeffrey single-roll crusher may be supplied with these new features.

Cross section and details of new single-roll crusher



Equipment Briefs

AN IMPROVED DESIGN of flexible coupling recently announced by the Falk Corp., Milwaukee, Wis., under the trade name of Steelflex, uses the basic principle employed previously in this company's flexible couplings, coupled with improvements making use of symmetrical design on both the driving and driven hubs and on the halves of the coupling cover which protect the operating elements and act as a grease reservoir. This coupling uses a resilient steel grid member to connect the driving and driven halves and is built in sizes ranging from 0.4 to 18,000 hp.

NEW ENAMELS and other finishes based on Bakelite resins, for which outstanding properties of wear resistance and resistance to sunlight and weathering are claimed, have been announced by the Everseal Manufacturing Co., Fisk Building, Broadway and 57th St., New York City. Among these is a floor enamel for covering wood, concrete and other materials, a mill white,

regular and heat-resistant aluminum finishes, regular and heat-resistant metal enamels and water and alcohol-resistant varnishes.

FOR MAINTAINING liquid level with a high degree of accuracy, the J. G. Russell Co., 103 Boston St., Boston, Mass., has announced a new liquid level control which is compact, light and simple in construction. The control consists of a float chamber electrically connected to a control box which in turn is connected to a switch or electrically operated valve. It is stated that no levers, linkages, stuffing boxes or other wearing parts are used in its construction.

A NEW MATERIAL known as Harvel Oil Stop, which is said to be proof against acid and alkali, oil and moisture and resistant to heat, has been announced by the Irvington Varnish & Insulator Co., Irvington, N. J. This material is a polymerized phenolic resin, chemically reacted to an insoluble stage at the point of application, without the use of heat, pressure or solvents. It is recommended by the manufacturers for stopping leaks under a wide variety of conditions.

A NEW TYPE of Brac-Kit, a first aid kit designed especially for industrial use, has been developed by the Davis Emergency Equipment Co., Graybar Bldg., New York City. The kit is firmly locked, with a dustproof and waterproof seal in an outer case, which can be permanently mounted in any convenient location. The kit can readily be unlocked, however, and its contents made available for immediate use. The kit holds ten unit cartons, containing dressing and treatments which can be selected to meet any need.

UNITED STATES Rubber Products, Inc., 1790 Broadway, New York City, has designed a new line of blower and dust suction hose said to be useful for practically any conveyor condition. Dust hose is designed for either suction or light pressure, such as that generated by a blower. It is stated to be highly resistant to abrasion and is available in diameters from 2 to 12 in. Blower hose, used for fumes only, is of lighter construction than dust hose, and is made in the same range of sizes.

MANUFACTURERS' LATEST PUBLICATIONS

Alloys. International Nickel Co., 67 Wall St., New York City—Bulletin C-6—28 pages on Monel metal and nickel in tanneries, comprising a singularly complete discussion of the use of these metals in leather manufacture.

Alloys. Ludlum Steel Co., Watervliet, N. Y.—Technical data book for engineers and designers, serving as a guide in the use of Silcrome stainless steels, with detailed instructions on methods of fabrication and information on grades of tool steel best suited for working.

Alloys. Revere Copper & Brass, Inc., 230 Park Ave., New York City—62-page general catalog on Herculoy, a new high-strength corrosion-resisting copper-silicon alloy, with information on properties, uses, welding, manufactured forms and corrosion resistance; engineering data included.

Chemicals. Atlas Powder Co., Wilmington, Del.—12-page booklet describing properties and uses of this company's new hexahydric alcohol, Sorbitol.

Chemicals. Plastics Department, E. I. du Pont de Nemours & Co., 350 Fifth Ave., New York, N. Y.—16-page booklet describing physical and chemical properties, working properties and molding of this company's new organic plastic, Lucite.

Chemicals. Wishnick-Tumpeer, Inc., 295 Madison Ave., New York City—Folder supplementing this company's more complete booklet, "Witco Products," listing some of the products supplied to paint, rubber, varnish, printing ink, leather, textile, paper, ceramic and other industries.

Compressors. Chicago Pneumatic Tool Co., 6 East 44th St., New York City—Bulletin 762—8 pages describing new portable and stationary diesel-engine-driven air compressors in three- and four-cylinder models.

Control Valves. The Bristol Co., Waterbury, Conn.—Bulletin 461—Bulletin describing this company's complete line of diaphragm control valves with information on construction, operating characteristics and applications.

Electrical Equipment. General Electric Vapor Lamp Co., Hoboken, N. J.—Catalog 603—12 pages, describing 12 common types of mercury-to-mercury and mercury-to-metal switches made by this company, with information on methods of use and factors influencing choice.

Electrical Equipment. National Acme Co., Cleveland, Ohio—4-page leaflet describing a new super-sensitive line voltage switch for a wide variety of applications. Also Bulletin 3707, 18 pages, on this company's Chronolog instruments for recording down time and operation of machinery.

Enameling. Porcelain Enamel & Manufacturing Co., Baltimore, Md.—Handbook explaining use of basic oxides in matching colors for porcelain enameling.

Equipment. Read Machinery Co., York, Pa.—10-page chemical machinery catalog covering a wide variety of mixers for liquid and plastic materials, acetylators, conveying equipment, weighing hoppers and weigh tanks, shredders, pharmaceutical machinery and other special process equipment.

Equipment. The Wolf Co., Chambersburg, Pa.—Bulletin 37—16 pages covering this company's equipment for grinding, flaking, dust collection, sifting, mixing, drying and other related operations.

Feeders. Omega Machine Co., 40 Penn Ave., Kansas City, Mo.—4 pages describing this company's chemical feeders for water treatment.

Filters. D. R. Sperry & Co., Batavia, Ill.—Catalog 5—40 pages completely describing filter presses and accessories, with engineering and application data.

Fire Protection. Walter Kidde & Co., 140 Cedar St., New York City—8-page bulletin, "Lux Makes the Difference," describing carbon dioxide fire protection equipment for use in industrial plants and with electrical machinery.

Heat Transfer. Griscom-Russell Co., 285 Madison Ave., New York City—Bulletin 1625—16 pages on heat-transfer apparatus with particular reference to special types of extended-surface heat-transfer tubing.

Heaters. American District Steam Co., North Tonawanda, N. Y.—Form 25-76—6 pages on water heaters, including one type for preventing freezing in elevated water tanks.

Heaters. Dravo Corp., Machinery Division, Dravo Building, Pittsburgh, Pa.—20 pages on this company's Lee oil and gas direct-fired unit heaters for industrial use.

Instruments. Brown Instrument Co., Philadelphia, Pa. Catalog 1102—48 pages covering the complete line of potentiometer pyrometers and millivoltmeter pyrometers made by this company.

Instruments. Esterline-Angus Co., Indianapolis, Ind.—Bulletin 737—4-page leaflet on the use of graphic instruments in the purchase and sale of power.

Instruments. Fischer & Porter Co., 110 West Penn St., Philadelphia, Pa.—Bulletin 100—19-page catalog on this company's Rotameter taper-tube flowmeters in indicating, recording and controlling models.

Instruments. General Electric Co., Schenectady, N. Y.—Bulletin GEA-1162A—2 pages on automatic starters for motor-driven pumps and compressors for maintaining constant pressure.

Instruments. Hellige, Inc., 3718 Northern Boulevard, Long Island City, N. Y.—12-page booklet describing advantages of this company's permanent glass color standards for pH comparators.

Instruments. Weston Electrical Instrument Corp., Newark, N. J.—4-page bulletin describing this company's high-speed photoelectric potentiometer.

Meters. Roots-Connersville Blower Corp., Connersville, Ind.—Bulletin 40B-12—16 pages describing rotary displacement meters and their use in gas measurement.

Power Transmission. Ajax Flexible Coupling Co., Westfield, N. Y.—16 pages with engineering data describing this company's flexible couplings for power transmission.

Power Transmission. Baldwin-Duckworth Chain Corp., Springfield, Mass.—Bulletin 60—24 pages with list prices and engineering data on standard hub sprockets for roller chains.

Power Transmission. Link-Belt Co., 307 North Michigan Ave., Chicago, Ill.—Catalog 1532—16 pages, giving sizes, dimensions and other pertinent data on friction clutches.

Power Transmission. The Oilgear Co., 1301 West Bruce St., Milwaukee, Wis.—Bulletin 47,000—55-page catalog covering detailed construction, characteristics, types and uses of this company's hydraulic variable speed transmissions and variable displacement pumps for hydraulic machinery.

Pumps. De Laval Steam Turbine Co., Trenton, N. J.—Catalog L-22—8-page discussion of construction and uses of this company's rotary displacement pump for handling oils at pressures up to 500 lb.

Steam Generation. Yarnall - Waring Co., Chestnut Hill, Philadelphia, Pa.—Bulletin WT-1805—16 pages on this company's water columns and water gages for boilers, for pressures up to 1,500 lb.

Welding. The Linde Air Products Co., 30 East 42d St., New York City—8-page booklet on steel hard-facing procedure; also 12-page booklet on advantages of welded joints in piping systems.

Chemical Engineering NEWS

CHEMICAL SHOW WILL FEATURE PROGRAMS IN CHEMICAL ENGINEERING

Advances of chemistry and chemical engineering as exemplified in the improvement of old products and in the development of new ones will be on display at the Sixteenth Exposition of Chemical Industries which will be held at Grand Central Palace, New York during the week of Dec. 6.

Chemicals, raw materials, and manufactured products to be presented at the Chemical Exposition will be shown in their relationship to the innumerable industries which depend upon them for starting point, or catalysis of process. Indicative of the wide variety of manufacturing which the products of a single company may serve is the case of one exhibitor, a manufacturer of synthetic organic chemicals. The industries affected are coating materials, such as paints and varnishes; adhesives, chewing gum, flooring materials, printing ink, rubber, road building, and waterproofing.

One exhibitor will exhibit cellulose acetate plastics, acetate yarn and some of the newer synthetic resin plastics, suitable for injection molding, a process that is being rapidly developed because of its high speed production possibilities. Among the specialty resins will be an alcohol-soluble, nitro-cellulose-compatible, coumarone resin. Auxiliary products will include a thermal-softening, resinous pitch, and a powerful, mild-odored, coal tar safety solvent. One product which the Exposition will feature is a high-boiling, mild-odored plasticizing oil for resins. Coumarone-indene resins will be included in this section of the Exposition.

Adaptable to the requirements of filtration and insulation, and as materials for filling, absorbing, or admixing, a complete line of high-quality diatomaceous silica products will be on display.

Chemists concerned with problems of refrigeration, especially the design of equipment in this field will be interested in the displays of refrigerants, including sulphur dioxide and methyl chloride. Also on display will be many accessories, including refrigerating oil and corrosion resisting materials.

Following an established custom, the student course in chemical engineering will be held during the week of the exposition. Prof. W. T. Read, Dean of Chemistry at Rutgers University, who has served as director of the student course at previous expositions, will again be in charge this year. Prof. Harry J. Masson, head of the department of chemical engineering at New York University, is chairman of the Educational Committee of the Exposition, under whose auspices the student course is held.

The Advisory Committee headed by Dr. M. C. Whitaker will serve as judges of the slogan contest which is being conducted under exposition auspices. A first award of $250 will be given to the person who, in the opinion of the judges, has submitted "the best descriptive expression encompassing the aims, and the benefits redounding to men from the activities of the chemical industries." The judging of hundreds of entries is at present going forward, and awards will be announced as soon as practicable. Presentation of prizes will be made at the exposition on Monday evening, Dec. 6.

Canadian Industries Wins Safety Award

Twenty of the 75 chemical companies in the First Chemical Section Safety Contest, sponsored by the National Safety Council, finished the six months' period from Jan. 1 to June 30 without a single disabling injury, according to a report to the 26th National Safety Congress held in Kansas City, Oct. 11-15. First prize trophies and second and third place certificates were presented to winners in three general divisions, classified according to type of operation. All competing units averaged 6.985 disabling injuries per one million man-hours or 32 per cent less than the average frequency rate for the entire chemical industry in 1936. Employees of all plants worked 35,073,740 hours.

Of the various divisions in the contest, the 20 largest units composing Group A of Division I had the lowest frequency rates, averaging 6.048. The outstanding no-injury record for the entire contest period was made by the "Dominion" Ammunition Division, Brownsburg, Que., of the Canadian Industries, Ltd., which worked 480,938 man-hours without a disabling injury. Almost two-thirds of the plants that completed the contest had rates below the average for their classification.

The Congress was held in the Municipal Auditorium and was supplemented by an exposition held in the main arena of the convention hall. There was on display a large and varied line of equipment for safeguarding operations of all kinds.

Electromet Contracts for Wilson Dam Power

Electro Metallurgical Co., unit of Union Carbide and Carbon Corp., has contracted to purchase from the Tennessee Valley Authority a large block of industrial power which it proposes to use at a new plant to be located in the Wilson Dam, Alabama, area. The contract will run for a period of 20 years, unless a 90-day option to cancel is exercised by the company.

The contract requires that the Authority be prepared to furnish as much as 40,000 kw. of power by 1941 should the company conclude to utilize such amount. The company will furnish its own transmission line to the boundary of the Tennessee Valley Authority property in the Wilson Dam area, where the delivery of the power will be made.

More Liming Materials Used In Agriculture

The National Lime Association has issued a report showing that a total of 6,305,426 tons of liming materials were used on domestic farms last year. This compares with a total of 3,291,789 tons so used in 1935. The tonnage includes ground limestone, limestone screenings, burned lime, hydrated lime, and marl. Mid-western states were the largest consumers, taking 4,928,935 tons of the 1936 total.

FOREIGN INVENTORS ENCOURAGED TO TAKE OUT PATENTS IN GERMANY

By PAUL WOOTON
Washington Correspondent
McGraw-Hill Publications.

FORCED to practice self-sufficiency in every possible way Germany is on the alert for new ideas. Her patent office gathers and makes available to German inventors published data concerning patents in every country that has a patent system. Drawings and specifications of more than 9,000,000 patents are on file. Inventors are encouraged to study this great flow of material with the hope that it will suggest ideas to them or that some of the ideas may be improved upon.

Every encouragement is held out to foreign inventors to take out German patents. It might seem that Germany's interest would be served best if foreigners patented their inventions in their own countries only, leaving Germans free to exploit the idea in their country. It has been found, however, that manufacture takes place on a high proportion of foreign patents. This creates employment and industrial activity. At present foreign patents constitute twenty-two per cent of those issued in Germany. In the United States the proportion is fourteen per cent. One third of the patents issued by the United States to residents of foreign countries go to Germans.

In recent years there has been a marked upturn in the number of agreements under which Germans use foreign patents and foreign manufacturers use German patents. Since it is difficult to get license or other payments out of Germany, unless payment can be made in goods, a custom of swapping patents has grown up. In this way payment is in the form of a valuable idea rather than in dollars, sterling or other foreign exchange.

There are issued in Germany more electrical patents than of any other classification. Automotive patents are in second place. Chemical patents are third, both in the number of applications and in the number issued.

German chemical manufacturers have reached the conclusion that a policy of secrecy and aloofness involves more loss than gain. Any improvement in processes or equipment cannot be monopolized for long, it has been found. As a consequence the whole trend is to make an invention available generally through license or other arrangement. This policy in Germany has been stimulated by barriers to trade. There are many interferences in exchanging goods. Relatively few difficulties are encountered in the exchange of ideas.

Germans have an aptitude for invention but their improvements upon and refinements of the inventions of others have contributed greatly to their reputation. While the foreign inventor may be the chief beneficiary from the original patent issued him in Germany the idea may furnish the basis for refinements that will carry it farther. Recognizing their genius for this sort of thing the German patent office keeps open house to foreigners and their own people alike. At no place in Germany was this correspondent more affably received.

The patent office maintains one of the largest technical libraries in the world. Books are not allowed to go out of the building. They must be used in the reading rooms. Request slips for books are averaging 50,000 a month this year. They have exceeded 500,000 annually for several years. The library subscribes for more than 1100 technical journals including *Chem. & Met.* and most of the other McGraw-Hill publications. The principal reason for maintaining this library is to aid inventors.

It is believed the facilities offered in the library of the German patent office since 1877 have been an important factor in making Germany the most inventive country in the world. Germany with half the population has applications for patents, in normal times, running nearly as high as those in the United States. They run far ahead of the number of applications filed by English, French, Italian or Canadian inventors. During the decade ended with 1936 Germans were granted 21,756 American patents and Americans were granted 12,123 patents by Germany. In 1929 Germany granted 2,992 patents to foreigners of which 1,185 were Americans. This fell to 1,649 in 1935 when Americans were issued 964 patents.

More persons are employed in the German patent office than in the U. S. Patent Office. Total personnel in the German office at the end of the 1937 fiscal year was 1,500 as compared with 1,350 in the United States. The German system with its senates composed of members that must qualify as judges uses fewer examiners. At the end of the last fiscal year Germany had only 352 examiners, while the U. S. Patent Office had 695 examiners on its staff.

Germany likes better its system of making applications for patent public than the American plan of keeping ideas secret until the patent is granted. Once a novel idea is known its army of inventors can go to work in efforts to improve upon it, when it is new and timely. In the United States the idea is buried from one to five years—a procedure which the Germans feel must reduce the rate of progress made in the various arts.

When application is made for a patent in Germany it goes at once to the examining board. The description must be sufficiently clear that those skilled in the art can duplicate the results. If the idea is found to be patentable the application is made public but the prior right of the inventor is protected unless infringement or other opposition can be established within three months. If no protest is filed the patent is granted. If protest is filed the application is referred to the appropriate division where three heads of division sit as judges. Witnesses are called and testimony taken. Witnesses may be compelled to attend. If the protestants are not satisfied the matter may be carried to one of the Patent Office divisions of appeal of which there are thirteen. A further appeal may also be taken directly to the Supreme Court.

In Germany, in addition to the fee of 25 reichmarks ($10) which must accompany the application there is a fee of Rm 30 ($12) payable when the patent is published. An annual fee of Rm 30 is charged after the second year. The annual fee is graduated upward to Rm 1,000 in the eighteenth year after which the patent lapses.

While the official rate of exchange is forty cents to the mark, those with more than casual dealings with Germany do not have to pay that amount for marks. There are various types of blocked marks. The regulations concerning their use are so many and so varied that only the Exchange Authority is familiar with all of them.

In the United States a fee of $30 is charged when application is made for a patent. An additional $30 is payable when the patent is granted. While the initial cost of securing an American patent is nearly three times that assessed in Germany there is no further fee, such as those levied in Germany, England and most other countries, to encourage manufacture. In Germany, however, patents of addition may be made to the main patent without charge. Matter not included in the original specification in the United States requires a separate application at the regular fee. When all this is considered the cost of securing a patent in Germany, despite the graduated tax, likely does not become greater until around the fifth year in which the German graduated tax becomes Rm 50 ($20).

Although Germans must manufacture after the third year under their own patent law, manufacture is not required under patents granted residents

of the United States provided manufacture is in progress in this country.

While most of the chemical patents granted to German inventors in the United States are assigned to German chemical firms, relatively few license agreements are registered. The same is true of patents taken out in Germany and assigned to American companies. These licenses constitute a private negotiation. There frequently are business reasons why these agreements should not be made public. In most cases there is nothing to be gained from recording the license. For these reasons the patent offices of the two countries can give no measure of the extent to which trafficing in patents is being carried on. That this is progressing at an increasing rate is common knowledge, however, among officials in each of the Patent Offices.

The German patent office has an "invention" of its own. Formerly the members of the staff did their dictating in the usual way. It was noted, however, that the character of the work of most of the officials was such as to make for many interruptions with the result that their stenographers frequently were idle. To meet that situation a stenographic pool was created. By dialing the figure 9 direct telephonic connection may be had with the pool. The telephone is used just as is a dictaphone. Whenever anyone has an idea he wants to get down on paper he picks up the telephone and dictates it no matter how brief it may happen to be. The writer saw the system in operation. It works. Stenographic expense is reduced by more than one-half.

Since the patent office demonstrated its practicability the system has been put into use in other government buildings.

T.V.A. Engineers Aid Idaho Phosphate Project

Engineers of the Tennessee Valley Authority have been working with representatives of Idaho, Montana, and Utah in a reconnaissance to determine what sort of phosphate processing plant should be built in this western territory. The conferences during September were intended to fix a preliminary basis for translating the results to date at Muscle Shoals into a plan applicable to Intermountain phosphate problem.

Funds for such ventures are not immediately available. Senator Pope would like to have the federal government pay the bill. The T.V.A. probably does not have spare cash, perhaps not the authority, to do this job out of its own Valley area. Relief funds will probably be sought. If the President does not approve such allotments, as seems likely, then state appropriations will be asked.

Lalor Foundation to Award Five Fellowships

The Lalor Foundation has announced a program of five fellowship awards of $2,500 each which will be granted for the academic year 1938-39. Applications are to be in the hands of the secretary, C. Lalor Burdick, by Dec. 31 and appointments will be made next February.

The awards will be for research work in various fields of chemistry and related sciences. They may be used for work anywhere in the United States or abroad. However, as a memorial to the late Dr. Arthur A. Noyes, Founder of the Research Laboratory of Physical Chemistry at the Massachusetts Institute of Technology, one of the awards will be specifically assigned to work at that institution.

Appointment is open to both men and women residents of the United States. No age limit is prescribed but the usual range of ages will be between 22 years and 40 years. Men and women in academic service who are on sabbatical leave or other leave of absence are among those eligible for appointment. Except in unusual cases the minimum requirement for consideration for the award will be the attainment of the Ph.D. degree, or its equivalent, prior to the submission of application.

CALENDAR

AMERICAN PETROLEUM INSTITUTE, annual meeting, Chicago, Ill., November 8–12.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, annual meeting, St. Louis, Mo., November 17–19.

AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS, Philadelphia, Pa., December 3 and 4.

16TH CHEMICAL EXPOSITION, Grand Central Palace, New York City, December 6-11.

INTERNATIONAL HEATING AND VENTILATING EXPOSITION, Grand Central Palace, New York City, January 24-28, 1938.

TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY, annual meeting, New York City, February 21-24, 1938.

AMERICAN CERAMIC SOCIETY, New Orleans, La., March 27-April 2, 1938.

AMERICAN CHEMICAL SOCIETY, semi-annual meeting, Dallas, Texas, April 18-21, 1938.

ELECTROCHEMICAL SOCIETY, Savannah, Ga., April 27-30, 1938.

Paint Production Men Will Meet in Cincinnati

The sixteenth annual meeting of the Federation of Paint and Varnish Production Clubs will be held in Cincinnati, Oct. 24-26 with headquarters at the Netherland-Plaza Hotel. The advisory committee will meet on Oct. 24 and the general meeting will open on the morning of Oct. 25 with the submission of club papers, followed by the annual report of President V. C. Bidlack. Reports of other officers, an address by E. T. Trigg, president of the National Paint, Varnish and Lacquer Association, committee reports, and election of officers will round out the day.

The paint show will open on Oct. 26 and the morning session on that day will be devoted to club papers and an address by Dr. H. A. Gardner, director of the Institute of Paint and Varnish Research. In the afternoon there will be a symposium under the auspices of the Plant Managers' Committee and in the evening the annual banquet will be held at which the newly elected president will be the principal speaker.

Oklahoma Will Open New Petroleum Laboratory

The new building of the Petroleum Experiment Station of the United States Bureau of Mines at Bartlesville, Okla., will be dedicated on Oct. 19 and 20. The Bartlesville Chamber of Commerce is cooperating in an extensive program to mark the dedication as a memorable occasion. The Governors and the Congressional delegation of Oklahoma and oil-producing States in the Mid-Continent area have been invited to attend the ceremonies, as well as other prominent Government officials and well-known figures in the petroleum and natural-gas industries.

New Oil Hydrogenation Plant for Hooker

Hooker Electrochemical Co., Niagara Falls, N. Y., is building a plant for hydrogenation of fatty oils at its Tacoma, Washington, site. The new plant will utilize byproduct hydrogen from electrolytic caustic soda and chlorine manufacture. The installation will include hydrogen compressors, high-pressure gas storage, hydrogen converters, oil refining equipment and extensive storage facilities for raw and finished oils. Total cost including buildings will be in the neighborhood of $110,000.

NEWS FROM WASHINGTON

Washington News Bureau
McGraw-Hill Publishing Co.
Paul Wooton, Chief

TROUBLES of business have worried official Washington very much for the past month. Government executives deny that they consider the stock market a suitable barometer. But they have paid attention to it as a storm signal and made fundamental changes of great importance to process industry.

Four distinct efforts have been made by the Federal Reserve Board as an offset for business pessimism. Lower rates for rediscount, desterilized gold, open market purchase of government securities, and a wider base for paper eligible for rediscount, all are part of the complete program. The objective was "continued easy credit" for expanding business.

Business continuing merely on previous good levels would not satisfy the situation. Officials know that American business men are happy only when they have more business and more profits than last year. Hence the concern for business expansion.

Apparently even Presidential attention to this problem has been secured. The tone of numerous addresses on his western trip indicates that the Chief Executive wishes to reassure business, as well as to encourage farmers, reclamation fans, hydro-power propagandists, and others. This has encouraged some to believe that the President has "turned to the right." But there is no real evidence to such effect noted in Washington by close observers.

British Trade Pact

It is now generally accepted that Secretary Hull and British trade representatives will get together on a reciprocal agreement in the near future. The present willingness of Britain to enter into such pact is believed to have arisen from the sharp shift in the policy of the Dominions. Those divisions of the Empire are clearly now almost as much interested in American trade as they are in Empire preference. And Britain must have the vigorous, wholehearted official cooperation of Washington under present conditions in Spain and the Far East.

Reduction of tariffs on many commodities of interest to the various divisions of the British Empire can be expected as a result of these negotiations. Spokesmen for chemical industry would apparently not be as much disturbed by this unquestioned fact if it were not also true that concessions granted thus to Britain become world-wide in effect under the most-favored-nation policy of this country.

Chemical executives will probably be startled by the scope of the list of commodities to be considered, when this is released. That there will be such a list, and that it will include all commodities under consideration, gives, however, an assurance that wholly unexpected cuts in tariff rate will not be promulgated, as was possible under the earlier policy of the State Department.

Offsetting these disturbing factors is the argument by some proponents of the trade agreement that such a pact would greatly benefit world trade generally. This, they argue, would help American manufacturers more than it would hurt.

Japan and Spain

Japan's conquest of China has not gone forward with anticipated speed. Japanese leaders are chagrinned and undoubtedly worried. Sharp restriction on imports of goods into Japan, as announced during the first week of October, gives confirming evidence that Nippon expects a long fight which makes necessary a conserving of funds and rationing of industry.

The direct effect of this on chemical trade can only be guessed at by the "experts" of Washington. It seems evident, however, that the indirect effects on our foreign markets for cotton, copper, hides, and other raw materials may be just as serious to the national income, and thus ultimately quite as bad for the chemicals producer. And certainly, the effect of this type of import restriction by Japan is vastly more serious than any of the embargoes which might have been issued by the President under the U. S. Neutrality Law.

The slow progress of Japan in its Oriental campaign has an important bearing on the policies of Continental Europe. Other dictatorships are disturbed. And the nations which have objected to Nazi-Fascist aid to General Franco in Spain are strengthened greatly in their "demands." Some of the closest observers of these matters in Washington seem to be in agreement that failure of Japan to carry forward its campaign in North China might even compel the withdrawal of Hitler and Il Duce from further operation on the Spanish "proving ground." Several more months of peace in Europe are assured, probably a long enough period to complete British rearmament and French stabilization to the point that no all-inclusive combat need be forecast.

New Bureau Station

Approximately as this issue of CHEM. & MET. reaches the reader, the Bureau of Mines will be dedicating at College Park, Md., a suburb of Washington, D. C., its new Eastern Experiment Station. That laboratory will house the staff of the nonmetallics group, formerly at New Brunswick, N. J., but not those others of the non-metallics division who have been, and will continue, at Tuscaloosa, Ala.

A number of research groups expected to deal with the early stages of fundamental studies of the Bureau will also be cared for at College Park. It is hoped that by the proximity of this station to Washington the major executives of the Bureau will thus have the best opportunity for keeping closely in touch with projects while in their infancy. If such projects thrive to the point that they may be weaned, they will then be transferred to the appropriate field stations elsewhere throughout the country.

During the first year about 25 scientific investigators will be housed in the new laboratories, including representatives of explosives, mining, and metallurgy divisions, as well as the nonmetallics group. The station will be under the direction of Dr. O. C. Ralston, who also is chief of the nonmetallics division.

New Power Uses

Contracts for the sale of power by Tennessee Valley Authority have been announced with six large enterprises. Five of these are electrochemical or electrometallurgical firms. It is estimated by the Authority that if all six of these major customers take the anticipated maximum of both primary and secondary (run-of-stream) energy, its gross income by 1941 may be as much as $4,300,000 per year.

Earlier contracts provided energy for the manufacture of Portland cement, aluminum, phosphorus and its derivatives (two contracts) and for industrial redistribution. The last addition to this industrial group was Electro Metallurgical Co., which promises in its contract to build a plant which initially will require 8,000 kw., and may by 1941 take as much as 40,000 kw. In all of the contracts the power cost will range from 2 to 3 mills per kw.-hr., depending upon the proportions of primary and secondary energy taken.

No like success has been achieved in the marketing of power from any other

(Please turn to page 640)

NEW REGULATIONS FOR TRANSPORTING DANGEROUS CHEMICALS IN ENGLAND

From Our London Correspondent

THE annual report of the Government Inspectors of Explosives for 1936 indicates the possibility of new regulations coming into force regarding the conveyance by road vehicles, of corrosive acids and other dangerous liquids. It is understood that draft regulations have already been agreed between representatives of various trade and transport interests and certain Government Departments, and copies of these regulations have been circulated to local authorities and others for comment. Recent accidents make it desirable for stricter transport conditions to be enforced, one particular accident which is cited in the report having involved the gasing of three people by hydrocyanic acid gas which was being conveyed in cylinders in a lorry which collided with a tramcar. In this particular instance the gas escaped because the central plug on one of the cylinders was dislodged by the impact of the collision. Safety recommendations concerning the handling of chlorine cylinders during transport have already been published in the form of a recent Home Office leaflet, in which the safety of chlorine as a compressed gas is also dealt with generally.

The use of hydrocyanic acid gas in the fumigation of buildings which are infested with vermin may also necessitate the introduction of stronger precautions, in view of a recent occurrence in London, when one person died and four other persons were badly gassed as a result of being in a house adjoining premises which were being fumigated.

The new Trade Marks (Amendments) Act, 1937, will come into force early next year, and its provisions should be studied by all who have any interest in British trade marks. A memorandum setting forth the principal changes in the law has been prepared by the Chartered Institute of Patent Agents, London. The new Act removes many of the obstacles which now stand in the way of the assignment of trade marks, and which have been unduly restrictive in modern business practice. For instance, it will no longer be necessary to transfer the goodwill of a business on the assignment of a registered trade mark if the goodwill does not pass and the matter of the assignment is advertised. The rights of a proprietor of a trade mark will be considerably strengthened under the new Act, in that he will have wider powers to stop others from using his trade mark in any way whatever in relation to their own goods.

The production of fertilizers from atmospheric nitrogen is to be undertaken by a new company which has been registered under the name of Nitrogen Fertilizers, Ltd. This new company, with a nominal capital of £10,000, is to enter into trading agreement with Fison, Packard and Prentice, Ltd., a well-known fertilizer manufacturing concern at Ipswich, and the West Norfolk Farmers' Manure and Chemical Co-operative Co., Ltd., at King's Lynn, but will also carry out research on the fixation of atmospheric nitrogen and the manufacture of its derivative compounds on a commercial scale. The West Norfolk Farmers' concern put into operation early this year a large sulphuric acid plant of the lead chamber type, which was designed and erected by the Moritz Chemical Engineering Co., of London and Paris. At the Ipswich works of Fison, Packard and Prentice there is a large plant for the manufacture of superphosphate by the Oberphos process.

A proposal to use byproduct blast-furnace and coke-oven gas, and low-grade waste coal, in a scheme to manufacture calcium carbide is at present under the consideration of the Government. It is proposed to burn the gas under boilers to raise steam for turbines or alternatively to drive gas engines after the gas has been purified and cleansed. Electric power would then be generated and used in the carbide furnaces. The scheme is novel in its utilization of cheap fuel which would otherwise be wasted, as an alternative to the generation and use of hydro-electric power. In Scotland surplus gas from existing and projected coke-ovens would be utilized, and the establishment of the industry in South Wales would make use of low-grade colliery duff. At present the British imports of carbide amount to about 60,000 tons per year; German imports are over three times this amount.

Imperial Chemical Industries has recently taken a large financial interest in a new cable making concern, Pyrotenax Ltd., with works at Hebburn-on-Tyne. It has now been confirmed that the Procter and Gamble Co. is entering the British market in an active way. The Newcastle and Manchester works of its English subsidiary, Hedley and Co. are to be enlarged, and new works are to be built on the banks of the Thames, near Purfleet, in Essex, to specialize in the manufacture of granulated soap and similar "American" products. Following the acquisition by Imperial Chemical Industries of the capital of Salt Union, Ltd., salt manufacturers have formed a British Salt Federation for the purpose of regulating the industry. As a first step the new federation has increased the price of salt in bulk by five to ten shillings per ton.

On the personal side are two occurrences to record. One is the death, at the age of 64, of Thomas Herd, sole managing director of the Distillers' Company, Ltd. Mr. Herd was also a member of the board of British Industrial Solvents, Ltd., and of the Distillers' Co. of Canada, Ltd. The other personal note is that J. H. G. Moneypenny, head of the research and technical department of Brown Bayley's Steelworks at Sheffield, has been elected chairman of the British Chemical Plant Manufacturers' Association.

At the recent British Pharmaceutical Conference at Liverpool, W. J. C. Dyke, of Evans, Sons, Lescher & Webb, Ltd., reported some valuable investigations upon the chemotherapeutical value of the aminobenzenesulphonamides, especially the para compound which appears to have achieved special prominence in streptococcal infections. This product is not being manufactured under patent rights and its preparation is therefore free to be undertaken by any firm to which manufacture appeals. At the same conference J. S. Toal, another member of the same firm gave some useful information regarding the stability of paraldehyde during storage. He revealed that, with phenol and resorcinol as preservatives, samples of paraldehyde had been kept for over six months and only a slight coloration had developed.

It is reported that the production of a wool-like synthetic fiber from casein may shortly be developed in the United Kingdom by Courtaulds, Ltd., manufacturers of artificial silk. It is said that the company has taken an active interest in a casein factory in Denmark, jointly with Danish dairy associations.

Oil Refining Engineering Course at Columbia

Design engineers active in industry will cooperate with members of the Department of Chemical Engineering at Columbia University in conducting a course in the principles of chemical engineering, to be sponsored during 1937-38 by Columbia Extension. Prof. Lincoln T. Work will be in charge.

Planned especially for petroleum refinery engineers, the course will analyze design as the outcome of engineering fundamentals. Topics covered in the first semester will include fluid flow, heat transfer, and the elements of distillation. During the spring session, students will consider distillation, absorption, adsorption, precipitation, crystallization, extraction, filtration, grinding, classification, evaporation, and drying.

GERMAN IMPORT AND EXPORT TRADE WTH CHINA AFFECTED BY HOSTILITIES

From Our German Correspondent

GERMANY, as well as America, is very much concerned over the Sino-Japanese conflict, and Germany's chemical industry is vitally interested in Far Eastern developments. Aside from interruptions in the supply of Chinese tung and other oils, Germany, as China's leading chemical supplier, is anxious not to lose this market. Last year China's total imports of chemical and allied products exceeded $31,000,000, of which Germany supplied 40 per cent, Japan 16 per cent, United States 14 per cent, and Great Britain 12 per cent. Germany supplied 33 per cent of China's imports of acids, and ranked first in supplying ammonium sulphate and other chemical fertilizers, potassium chlorate, extensively used in the match industry, and was a keen competitor in dyestuffs with Japan.

Ships for the Far East are leaving German harbors without part of their already booked cargoes, and new freight business is practically paralyzed. Germany's exports to China for the first six months of 1937, before the outbreak of hostilities, reached 78 million RM as against 132 million RM for the whole of 1936. Of Japan's 2,920 million Yen imports in 1936 the greatest increases were recorded for cotton, heavy oils, rubber, and ammonium sulphate, but in Japan's total imports Germany figures only after U.S.A., British Empire, Manchukuo, and China.

Apparently because of the Spanish civil war and heavy French consumption, German potash exports so far this year are nearly 40 per cent higher than in 1936. The Potash Syndicate's total sales, which fell to 850,000 tons (pure potash content) in 1932, rose last year to 1,360,000 tons, only slightly below the pre-depression level. The increase has been mainly due to home sales, but the recent cut in domestic price is temporarily causing the German Kali producers some financial difficulties.

A significant development in Germany's economic penetration of the Danubian basin is the formation of the "Gesellschaft zur Erforschung Auslaendischer Erzorkommen m.b.H.," recently capitalized in Berlin for one-half million RM. Jugoslavia is the first country in which this company will begin carrying out its program of developing foreign ore deposits. One of Germany's leading chemical concerns already owns and operates large soy bean plantations in the Balkans.

A further increase in the production of industrial fats and oils is expected through better utilization of waste materials, especially bones. Since it is estimated that only one-fifth of the 450,000 tons of bones resulting from industrial production are utilized annually, a new decree of the Government Chemical Industries Board prohibits the burning of bones or their disposal as refuse and requires that in the future all industries must offer bones resulting as a byproduct for sale to authorized dealers for recovery of fats, glue, and fertilizer.

To reduce industrial fat consumption, which accounted for 20 per cent of Germany's total fat requirements of 1,968,000 tons in 1936, synthetic fatty acids have been produced successfully in pilot plants, and a large-scale commercial plant is nearing completion, according to Wilhelm Keppler, raw- and manufacturing-materials chief. At Witten in the Ruhr, synthetic fatty acids are being produced from coal according to the Imhausen-Troschke process in the "Deutsche Fettsauerewerk G.m.b.H.," affiliated with the leading soap companies "Persilwerke Henkel" of Dusseldorf and the "Maerkische Seifenindustrie" of Witten. The output is to be used for technical as well as household purposes, but chiefly for making soap and lubricants.

Since soap manufacture accounts for the largest part of industrial fat consumption, the average fat content of German soaps has been steadily reduced. Difficulties have been experienced, however, in overcoming consumer prejudices against so-called "filled" soaps. Soap manufacturers and government authorities are reluctant to cut down the production of washing flakes with heavy fat content, especially since these are essential if the increasing amounts of staple fibre and rayon fabrics are to be washed without injury. A warning was also expressed by Prof. Schrauth of Berlin at the recent Frankfurt chemical congress against the danger in the fat field of trying to develop "Ersatz" materials as of world war days. He stated that the only really useful new "substitute," or "Exchange" products as they are now called in Germany, must also be able to stand up in competition in world markets.

With rapeseed production increasing as a result of government subsidy, the rapeseed crop is being processed in a Magdeburg factory into a hardened and purified rapeseed table fat now being introduced on the German market.

Margarine production also increased by 5 per cent to 423,000 tons in 1936, although total production is still below the 1929 peak. Two-fifths of the total plant fats and oils are consumed in Germany's 135 margerine factories.

To secure a larger supply of oil for her margarine production, Germany is now actively entering the whaling field. A blue whale, averaging 70 tons, according to a report at the Frankfurt meeting, yields 23 to 25 tons raw oil. To produce the same quantity of oil would otherwise require 150 tons soy beans, 60 tons peanuts or rapeseed, or 450 hogs averaging 300 lb. in weight. On newly-built German whaling boats and in cooperation with Norwegian whalers, German experts are working on new processes by which it is hoped to increase the oil extraction per whale considerably. Whaling research institutes have recently been established in Wiesbaden, Germany, and in Norway.

While aluminum prices abroad were raised in March of this year, Germany, which consumed over one-fourth the world's production in 1936, reduced the price from 1.44 RM to 1.33 RM per kilogram on July 1. Effective Aug. 1 and Sept. 1, the prices of aluminum alloys and aluminum products were also required to be lowered correspondingly by the Reich Price Commissioner.

On Sept. 1 the price of staple fibre (Zellwolle) was again reduced by 10 per cent by order of the Price Commissioner, from 1.60 RM per kilogram to 1.45 RM. Considering that the price a few years ago was 3.80 RM and that the quality of the fibre has improved this reduction illustrates the lowering of unit costs with increasing manufacture, and brings the purchase price for staple fibre nearer that for foreign cotton (cotton paid for in foreign exchange: 0.80 RM per kg.; cotton paid for in RM, so-called "Reichsmark cotton": 1.15 RM per kg.).

Before the end of the year Germany's staple fibre production should exceed that of Italy. Although a German group has acquired rights to the Italian "Lanital" Casein process of Ferretti for synthetic wool fibres, imported and domestic wood continues to be the chief staple fibre raw material in Germany. I. G. Farben's new Wolfen plant, the largest in the world, is treating domestic beech wood according to sulphite and nitric acid processes. A new process has been developed to eliminate certain intermediate stages of production so that the staple fibre can be torn and processed directly without being cut into small pieces before being spun. Recently a "Zellwoll - Spinnbad - Vereinigung" was formed in Berlin by textile groups cooperating with I. G. Farben to develop simpler and cheaper production methods to eliminate the combing process heretofore required.

PERSONALITIES

✦ RALPH L. WILSON, formerly metallurgical engineer for the Timken Steel & Tube Division of the Timken Roller Bearing Co., has become associated with the Climax Molybdenum Co. as metallurgical engineer in its development field.

✦ CHARLES D. LUKE last month began his new duties as assistant professor of chemical engineering at Syracuse University. Dr. Luke came to Syracuse from the De Florez Engineering Co. of New York and prior to this association was in the process engineering division of the Standard Oil Co. of Louisiana.

✦ C. W. PARMELEE, head of the department of ceramic engineering, University of Illinois, was elected to honorary membership in the German Ceramic Society at its anual meeting held recently in Freiburg, Germany.

Gustav E. F. Lundell

✦ G. E. F. LUNDELL has been appointed chief of the chemistry division of the National Bureau of Standards, Department of Commerce, to fill the vacancy caused by the retirement of Percy H. Walker last July. Dr. Lundell is a former assistant professor of analytical chemistry of Cornell University and since 1919 has had charge of the section of metal and ore analysis of the Bureau's Chemistry Division.

✦ H. M. PATTON, formerly with the Pittsburgh Steel Co., has joined the staff of the research and development division of the Jones & Laughlin Steel Corp.

✦ MERRILL N. DAVIS, executive vice-president and secretary of the S. R. Dresser Manufacturing Co., Bradford, Pa., has been elected president of the Association of Gas Appliance and Equipment Manufacturers.

✦ SUSAN E. DOEBBELING, who has been specializing on enzyme work at Columbia University, is now associated with the Takamine Laboratory, Inc., Clifton, N. J., where she will continue her research on enzymes with particular attention to their aplication in industry.

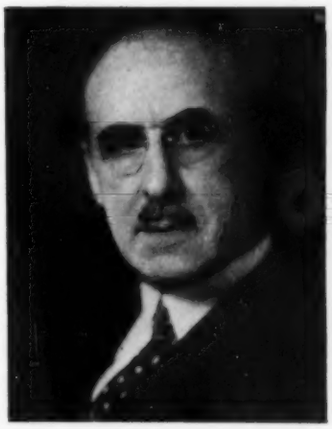
✦ LASZLO AUER, well known in the field of synthetic lacquers and a former chief of the research division of Imperial Chemical Industries, has been appointed chief chemist in the laboratories of John D. Lewis, Inc., resin manufacturer of Mansfield, Mass.

✦ E. A. ROBINSON has been appointed technical director of the industrial department of National Oil Products Co., Harrison, N. J., and will be in charge of the textile, tanning, paper, specialties, Metanac and product research units of that organization. Dr. Robinson was formerly with the Tennessee Eastman Corp.

✦ JOHN H. HALL has resigned his position as technical assistant to the president of Taylor-Wharton Iron & Steel Co., High Bridge, N. J., to start a private practice as consulting metallurgical engineer.

✦ DAVID G. ANDERSON, JR., Ph.D. candidate in chemical engineering at Columbia University, has been appointed instructor in chemical engineering at New York City College.

✦ DONALD PRICE, former chemistry instructor at Columbia University, has been appointed chief chemist of the research laboratory of National Oil Products Co.



Frederick M. Becket

✦ FREDERICK MARK BECKET, president of Union Carbide & Carbon Research Laboratories, Inc., and vice-president of the Electro Metallurgical Co. and the Union Carbide & Carbon Corp., received the Acheson Medal of the Electrochemical Society at its recent meeting in St. Louis.

✦ ALBERT A. WOLL, a regent graduate of Massachusetts Institute of Technology, has joined the technical staff of Wishnick-Tumpeer, Inc.

OBITUARY

✦ CLAUDE L. HIPPENSTEEL, chemical engineer and member of the technical staff of the Bell Telephone Laboratories, New York, died September 20 at Montclair, N. J., after a long illness. He was 40 years of age. Mr. Hippensteel will be remembered by the profession for his research on the atmospheric corrosion of protective metal coatings on iron and steel and on the mechanical testing of rubber insulation.

✦ WILFRED NEWSOME STULL, vice-president in charge of operations and research of the Mallinckrodt Chemical Works, St. Louis, died September 17 at Brunswick, Me., at the age of 61 years. He had been with the Mallinckrodt organization since 1904.

Chemical ECONOMICS and MARKETS

CHEMICAL OUTPUT EXPECTED TO EXPAND IN FOURTH QUARTER

IN ITS report for August, the Federal Reserve Board credits an advance in general business and industrial activity. Industrial production advanced to levels close to those of last spring, the board reported, while factory employment fell off during the month, according to seasonally adjusted index which stood at 102.3 for August compared with 103.0 for July. Payrolls on the other hand advanced from 100.4 of the 1923-25 average in July to 103.7 in August.

The industrial production index stood at 117 for August compared with 114 for June and July and 118 for last spring. Early reports for September, the board reports, indicate a decline in steel output and a seasonal decrease in the production of automobiles. In the nondurable goods industries output increased reflecting chiefly increases in cotton and woolen mills. Shoe production gain was less than seasonal.

The index of construction contract awards for August stood at 65 compared with 68 for July, reflecting a decline in both residential and other construction. The Bureau of Labor, however, reported a gain in building in August with permits issued in 1,456 localities showing an increase over July of 6.1 per cent in number and 5.6 per cent in value. This report also stated that compared with August last year non-residential building permits gained 2.3 per cent in number and 24.6 per cent in value, while residential decreased 3.3 per cent in number and 23.1 per cent in value. Permits of all kinds increased 1.9 per cent in number but decreased 3.6 per cent in value.

The outlook for the movement of goods in the last quarter of this year is favorable. The Shippers Advisory Boards anticipate an increase of 6.2 per cent in freight carloadings for the fourth quarter as compared with those for the fourth quarter of last year.

All 13 boards, except those for the Ohio Valley and Pacific Northwest, estimated an increase for the fourth quarter of 1937 compared with the same period in 1936. The greatest gain anticipated is that of the Southwest, which estimates that freight car requirements in the quarter will be 27 per cent above the fourth period last year, due in large part to the heavier movement of grain, cotton, cottonseed, and products except oil, vegetables and coal. Loading of grain in that territory is expected to be more than three times as great as in the same period last year and for cotton an increase of 60 per cent is anticipated.

Percentages of increase for some of the commodity groups for the quarter is as follows: coal and coke, 3.3; salt, 9; petroleum and products, 4.9; lime and plaster, 6.7; automobiles, 14.6; fertilizers, 1.1; paper, paper board, and prepared roofing, 4.8; and chemicals and explosives, 0.3.

Complete statistics are not yet at hand regarding industrial activity in the chemical and allied industries for the third quarter of the year. Silk consumption, as measured by mill deliveries, was 36,372 bales in September which represents an increase of 2,815 bales over the preceding month but a drop of 9,337 bales from the September, 1936 total. Latest available data for other important chemical-consuming industries refer to activities for August.

One of the encouraging features of the August statistics is found in the relatively high automotive output for that month. While production declined in September, there was a recovery in October and the outlook for the last quarter is regarded as promising.

In the chemical industry spotty conditions were reported during August and September. In some cases a regular movement to consuming industries was reported but in the larger number of cases a more moderate call for materials was experienced and the total movement for the third quarter unquestionably was below that for the second quarter. This may be explained, in part, by the fact that buying in June was heavy in some commodities because of higher prices which were to become effective for the third quarter. As a result, many consumers were stocked ahead and, as the price scare has subsided, are working to reduce rather than to build up inventories of raw materials.

In general the chemical business may be described as good. It has not continued along a steadily rising line but it is considerably above the 1936 level for the year to date and the final quarter appears to be in line for about the same result as reported for the final quarter of last year.

Foreign demand for American chemicals and related products in July continued at the record level that has been maintained in recent months and were 27 per cent higher, measured by value, than in July, 1936, according to official figures. The aggregate value of such shipments during the month reached $16,523,000, which compares with $17,000,000 in June and $13,011,000 in July, 1936.

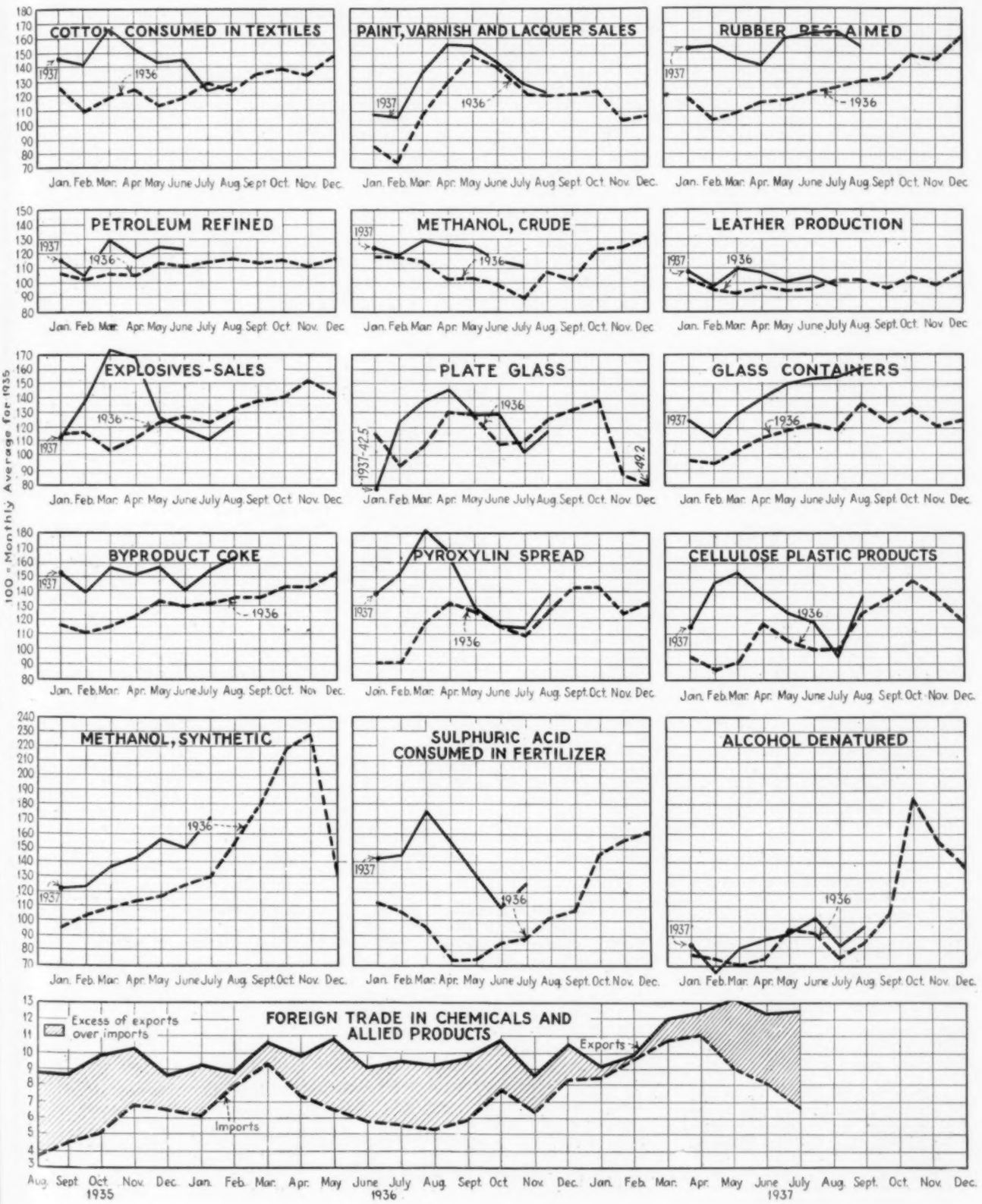
Compared with July, 1936, every leading item on the chemical and related product export list, with the single exception of turpentine, recorded value gains during the current July though some, notably naval stores, and sulphur, showed losses in volume.

Exports of crude and refined sulphur which have been lagging in recent months, due to the difficulty of securing bottoms, recovered somewhat in July during which shipments aggregated 73,422 tons valued at $1,121,600 against 56,290 tons valued at $1,151,000 in June and 37,527 tons valued at $696,000 in July, 1936.

Production and Consumption Data for Chemical-Consuming Industries

	Aug. 1937	Aug. 1936	Jan.-Aug. 1937	Jan.-Aug. 1936	Gain for Jan.-Aug. 1937 per cent
PRODUCTION					
Alcohol, denatured, 1,000 wi. gal.	7,932	6,953	56,386	52,050	8.3
Automobiles, number	394,322	271,274	3,622,139	3,200,565	13.2
Byproduct coke, 1,000 tons	4,571	3,871	34,689	28,246	22.8
Cellulose acetate plastics, 1,000 lb	1,416	1,162	9,685	7,678	26.1
Nitrocellulose plastics, 1,000 lb	1,642	1,463	13,264	10,350	28.1
Glass containers, 1,000 gr	5,259	4,403	36,730	29,059	26.4
Plate glass, 1,000 sq. ft	17,898	18,710	139,820	137,218	1.9
Rosin, wood, bbl	68,332	58,572	501,097	430,165	16.5
Turpentine, wood, bbl	10,410	8,785	77,650	69,061	12.4
Rubber reclaimed, tons	15,289	12,124	122,042	90,467	34.9
Steel barrels, number	773,025	595,254	6,799,941	5,248,779	29.5
CONSUMPTION					
Cotton, 1,000 bales	604	575	5,377	4,502	19.4
Silk, bales	33,557	42,016	299,184	283,810	5.4
Explosives, 1,000 lb	30,811	32,567	248,429	209,997	18.3
Rubber, crude, tons	41,456	46,777	397,113	378,727	4.8
Paint, varnish and lacquer sales, $1,000	35,305	36,005	306,368	267,895	14.3

TRENDS OF PRODUCTION AND CONSUMPTION



PRICE CHANGES OF INTEREST IN MARKET FOR CHEMICALS AND OILS

DEMAND for chemicals has increased somewhat in the last two weeks but trading is far from active and in some cases contract withdrawals have been slower than anticipated. Total movement however reaches a good tonnage. Consumer stocks are said to have been reduced in recent weeks. Different factors have contributed to slow up industry in general and this condition has extended to the market for chemicals. The outlook, however, seems to be favorable for a fairly active last quarter for the chemical industry.

Prices have been an important factor on the state of manufacturing activities. In the first place, buying of chemicals was speeded up earlier in the year in order to build up inventories in anticipation of price advances. This was followed by a slower trading movement, partly because consuming industries were operating on a reduced scale and partly because they were well supplied with raw materials. At present, the price trend is downward for many commodities, consuming industries are a little more active, and raw material accumulations have been reduced.

Price fluctuations in the last month have been quite numerous and have been in both directions. Higher prices have been in effect for white lead and for leaded zinc oxides but since the announcement of the advances, the metal market has dropped in price and lower quotations have been established for lead oxides and acetate of lead. Copper and tin salts also have sold at reduced figures following the drop in basic metals.

Turpentine and rosins have been under pressure with some selling of government-owned stocks. Acetate of lime and acetic acid also have been prominent among the chemicals for which lower prices ruled.

CHEM. & MET.
Weighted Index of
CHEMICAL PRICES

Base = 100 for 1927

This month	**90.21**
Last month	90.48
October, 1936	86.76
October, 1935	87.01

The market has been irregular with price changes rather numerous. The trend has been downward with spirits of turpentine reaching new low levels. Metal salts have followed the metal markets, moving up and down in price.

The price situation also seems to be the most prominent factor in the market for vegetable oils. To begin with a relatively low-priced market has been reported for cottonseed oil. As the seed supply promises to be large the downward trend may continue for the immediate future. A price reversal seems assured when a larger part of the crude oil supply passes to refiner ownership because consuming demand for refined oil should be heavy in succeeding months and in view of the position of competing materials, it is possible that the present cotton oil year may establish a record for volume of sales.

Correction in Employment Data

In our presentation of the employment data based on the National Industrial Conference Board's survey made for the Chemical Alliance, Inc., the "total earnings for 1936" shown on page 531 of Part II, September *Chem. & Met.* are not directly comparable with the numbers of salaried and hourly workers shown directly above. Other reports, however, show that all hourly workers in the chemical manufacturing industry in the North had an average annual income in 1936 of $1,387 and in the South, $1,034. Salaried workers for the representative week of April 28, 1937, had an averge weekly income of $50.34 in the North and $43.72 in the South.—EDITORS.

In contrast to the price movement for cottonseed oil, a very strong market has been met in the case of most paint-making oils. China wood oil has been affected by the inability to move stocks from primary markets. Last shipments are said to have left Chinese ports early in August with no indications when shipments will be made in the future. Hence domestic markets are feeling the pressure of small supplies as expressed in rising prices with these prices becoming nominal as offerings diminish. Recourse to substitute oils on the part of China wood oil users is restricted because other drying oils, such as perilla and oiticica, are also in limited supply and linseed oil may find a wider outlet as a result of this condition. The opening of a market for trading in linseed oil futures has not attracted much attention so far either in the way of speculative or hedge trading.

A report from Canada states that by Order in Council dated Sept. 1, butyl alcohol when imported for use in Canadian manufacturers is accorded free entry from all countries from Sept. 1, 1937 to Feb. 28, 1938. In 1936 Canada imported 1,728,989 lb. of butyl alcohol of which 1,628,189 lb. valued at $152,346 came from the United States.

Italy Looks for New Source of Motor Fuel

Further developments in Italy's campaign for self-sufficiency are described in reports to the Bureau of Foreign and Domestic Commerce from Rome. The government there is lending aid to the formation of S. A. Liquigas of Milan the purpose of which is the construction of plants at Mestre for the utilization of butane and propane from petroleum refiners of the A.G.I.P. at Porto Marghera. The gases are to be liquefied and sold under the name of "liquigas." Use of butane and propane for household purposes is virtually unknown in Italy, but the company plans extensive pioneering work aimed at homes lacking ordinary municipal gas supplies.

Italy also is studying possibilities of other gases as motor fuels—a serious question with her. She has production of natural methane and in an agreement with Salsomaggiore Company an experimental firm is to operate the natural springs and wells at Salsomaggiore for production of mineral waters, iodine and natural methane gas. Other experiments are reported from Italy, which is testing liquid ammonia as fuel for motor trains and automobiles.

Denmark with its surplus of skimmed milk suitable for the manufacture of casein is manifesting considerable interest in Italy's use of this product in the manufacture of artificial yarn, reports from Copenhagen state. Denmark's exports of casein to Italy increased 155 per cent to a total of 866 metric tons during the first half of the current year.

The Dairy Manufacturers' Association of Japan has succeeded in developing a process for the manufacture of casein from skimmed milk and will establish factories in different sections of Hokkaido in the near future.

CHEM. & MET.
Weighted Index of Prices for
OILS AND FATS

Base = 100 for 1927

This month	**84.78**
Last Month	88.80
October, 1936	92.56
October, 1935	94.08

Drying oils have held a strong price position with China wood and perilla in relatively small supply. Cottonseed, soya, peanut, and corn oils were weak and animal fats also were lower.

Current PRICES

INDUSTRIAL CHEMICALS

	Current Price	Last Month	Last Year
Acetone, drums, lb.	$0.06 –$0.07	$0.06 –$0.07	$0.08 –$0.09
Acid, acetic, 28%, bbl., cwt.	2.38 – 2.63	2.53 – 2.78	2.45 – 2.70
Glacial 99%, drums	8.43 – 8.68	8.70 – 8.95	8.43 – 8.68
U. S. P. reagent	10.25 –10.50	10.75 –11.00	10.52 –10.77
Boric, bbl., ton	105.00–115.00	105.00–115.00	105.00–115.00
Citric, kegs, lb	.24 – .27	.25 – .28	.25 – .28
Formic, bbl., ton	.11 – .11½	.11 – .11½	.11 – .11½
Gallic, tech., bbl., lb	.75 – .78	.60 – .65	.60 – .65
Hydrofluoric 30% carb., lb.	.07 – .07½	.07 – .07½	.07 – .07½
Lactic, 44%, tech., light, bbl., lb.	.06½– .06¾	.06½– .06¾	.11½– .12
Muriatic, 18°, tanks, cwt.	1.05 –.....	1.05 –.....	1.00 – 1.10
Nitric, 36°, carboys, lb.	.05 – .05½	.05 – .05½	.05 – .05½
Oleum, tanks, wks., ton	18.50 –20.00	18.50 –.....	18.50 –20.00
Oxalic, crystals, bbl., lb.	.10½– .12	.10½– .12	.11½– .12½
Phosphoric, tech., c'bys., lb.	.09 – .10	.09 – .10	.09 – .10
Sulphuric, 60°, tanks, ton	13.00 –.....	13.00 –.....	11.00 –11.50
Sulphuric, 66°, tanks, ton	16.50 –.....	16.50 –.....	15.50 –.....
Tannic, tech., bbl., lb.	.40 – .45	.26 – .30	.20 – .30
Tartaric, powd., bbl., lb.	.24½– .25½	.24½– .25½	.24 – .25
Tungstic, bbl., lb.	2.75 –.....	2.75 –.....	2.50 – 2.75
Alcohol, Amyl	–.....	–.....	–.....
From Pentane, tanks, lb.	.12⅝–.....	.12⅝–.....	.14⅜–.....
Alcohol, Butyl, tanks, lb.	.08½–.....	.08½–.....	.08½–.....
Alcohol, Ethyl, 190p'f., bbl., gal.	4.14 –.....	4.14 –.....	4.27½–.....
Denatured, 190 proof			
No. 1 special, dr., gal wks.	.34 –.....	.34 –.....	.32 –.....
Alum, ammonia, lump, bbl., lb.	.03 – .04	.03 – .04	.03 – .04
Potash, lump, bbl., lb.	.03½– .04	.03½– .04	.03 – .04
Aluminum sulphate, com bags cwt.	1.35 – 1.50	1.35 – 1.50	1.35 – 1.50
Iron free, bg., cwt.	2.00 – 2.25	2.00 – 2.25	2.00 – 2.25
Aqua ammonia, 26°, drums, lb.	.02½– .03	.02½– .03	.02½– .03
tanks, lb.	.02½– .02¾	.02½– .02¾	.02½– .02¾
Ammonia, anhydrous, cyl., lb.	.16 –.....	.16 –.....	.15½– .16
tanks, lb.	.04½–.....	.04½–.....	.04½–.....
Ammonium carbonate, powd tech., casks, lb.	.08 – .12	.08 – .12	.08 – .12
Sulphate, wks., cwt.	1.42½–.....	1.42½–.....	1.25 –.....
Amylacetate tech., tanks, lb.	.11½– .12	.11½– .12	.12 –.....
Antimony Oxide, bbl., lb.	.15½– .16	.15½– .16	.12½– .13
Arsenic, white, powd., bbl., lb.	.03 – .03¾	.03 – .03¾	.03¼– .04
Red, powd., kegs, lb.	.15½– .16	.15½– .16	.15½– .16
Barium carbonate, bbl., ton	52.50 –57.50	52.50 –57.50	56.50 –58.00
Chloride, bbl., ton	72.00 –74.00	72.00 –74.00	72.00 –74.00
Nitrate, cask, lb.	.07 – .08	.07 – .08	.08½– .09
Blanc fixe, dry, bbl., lb.	.03½– .04	.03½– .04	.03½– .04
Bleaching powder, f. o. b., wks., drums, cwt.	2.00 – 2.10	2.00 – 2.10	2.00 – 2.10
Borax, gran., bags, ton	46.00 –51.00	46.00 –51.00	44.00 –49.00
Bromine, cs., lb.	.36 – .38	.36 – .38	.36 – .38
Calcium acetate, bags	1.95 –.....	2.25 –.....	2.10 –.....
Arsenate, dr., lb.	.06½– .07	.06½– .07	.06 – .07
Carbide drums, lb.	.05 – .06	.05 – .06	.05 – .06
Chloride, fused, dr., del., ton	20.00 –33.00	20.00 –33.00	20.00 –33.00
flake, dr., del., ton	22.00 –35.00	22.00 –35.00	22.00 –35.00
Phosphate, bbl., lb.	.07½– .08	.07½– .08	.07½– .08
Carbon bisulphide, drums, lb.	.05 – .06	.05 – .06	.05½– .06
Tetrachloride drums, lb.	.05½– .08¾	.05½– .06	.05½– .06
Chlorine, liquid, tanks, wks., lb.	2.15 –.....	2.15 –.....	2.15 –.....
Cylinders	.05½– .06	.05½– .06	.05½– .06
Cobalt oxide, cans, lb.	1.67 – 1.70	1.67 – 1.70	1.41 – 1.51
Copperas, bgs., f.o.b., wks., ton	15.00 –16.00	15.00 –16.00	15.00 –16.00
Copper carbonate, bbl., lb.	.09 – .16½	.10½– .19	.11½– .16
Sulphate, bbl., cwt.	5.00 – 5.25	5.15 – 5.40	4.00 – 4.25
Cream of tartar, bbl., lb.	.19½– .20	.19½– .20	.16½– .17
Diethylene glycol, dr., lb.	.22 – .23	.22 – .23	.16½– .20½
Epsom salt, dom., tech., bbl., cwt.	1.80 – 2.00	1.80 – 2.00	1.80– 2.00
Ethyl acetate, drums, lb.	.07½–.....	.07½–.....	.07 –.....
Formaldehyde, 40%, bbl., lb.	.05½– .06½	.05½– .06½	.06 – .07
Furfural, dr., lb.	.10 – .17½	.10 – .17½	.10 – .17½
Fusel oil, ref. drums, lb.	.16 – .18	.16 – .18	.16 – .18
Glaubers salt, bags, cwt.	.95 – 1.00	.95 – 1.00	.85 – 1.00
Glycerine, c.p., drums, extra, lb.	.23½–.....	.23½–.....	.19½–.....
Lead:			
White, basic carbonate, dry casks, lb.	.08 –.....	.08 –.....	.06½–.....
White, basic sulphate, sck., lb.	.07½–.....	.07½–.....	.06 –.....
Red, dry, sck, lb.	.08½–.....	.09 –.....	.07 –.....
Lead acetate, white crys., bbl., lb.	.12 – .13	.13½– .14	.10½– .11
Lead arsenate, powd., bbl., lb.	.11½– .12	.11½– .12	.09 – .10
Lime, chem., bulk, ton	8.50 –.....	8.50 –.....	8.50 –.....
Litharge, pwd., csk., lb.	.07½–.....	.08 –.....	.06 –.....
Lithophone, bags, lb.	.04½– .04¾	.04½– .04¾	.04½– .05
Magnesium carb., tech., bags, lb.	.06 – .06½	.06 – .06½	.06 – .06½

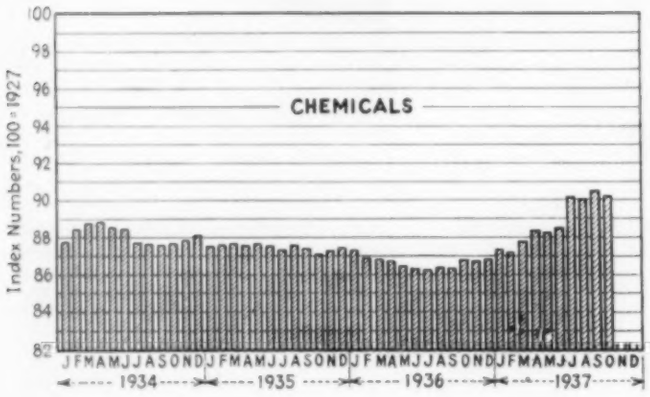
	Current Price	Last Month	Last Year
Methanol, 95%, tanks, gal.	.31 –.....	.31 –.....	.33 –.....
97%, tanks, gal.	.32 –.....	.32 –.....	.34 –.....
Synthetic, tanks, gal.	.33 –.....	.33 –.....	.35½–.....
Nickel salt, double, bbl., lb.	.13 – .13½	.13 – .13½	.13 – .13½
Orange mineral, csk., lb.	.11½–.....	.12 –.....	.10 –.....
Phosphorus, red, cases, lb.	.40 – .42	.40 – .42	.44 – .45
Yellow, cases, lb.	.24 – .30	.24 – .30	.28 – .32
Potassium bichromate, casks, lb.	.08½– .09	.08½– .09	.08½– .09
Carbonate, 80–85%, calc. csk., lb.	.06½–.....	.06½–.....	.07 – .07½
Chlorate, powd., lb.	.09½–.....	.09½– .09	.08 – .08½
Hydroxide (c'stic potash) dr., lb.	.07 – .07½	.07 – .07½	.06½– .06½
Muriate, 80% bgs., ton	23.00 –.....	23.00 –.....	22.00 –.....
Nitrate, bbl. lb.	.05½– .06	.05½– .06	.05½– .06
Permanganate, drums, lb.	.18½– .19	.18½– .19	.18½– .19
Prussiate, yellow, casks, lb.	.15 – .16	.15 – .16	.18 – .19
Sal ammoniac, white, casks, lb.	.05 – .05½	.05 – .05½	.04½– .05
Salsoda, bbl., cwt.	1.00 – 1.05	1.00 – 1.05	1.00 – 1.05
Salt cake, bulk, ton	13.00 –15.00	13.00 –15.00	13.00 –15.00
Soda ash, light, 58%, bags, contract, cwt.	1.23 –.....	1.23 –.....	1.23 –.....
Dense, bags, cwt.	1.25 –.....	1.25 –.....	1.25 –.....
Soda, caustic, 76%, solid, drums, contract, cwt.	2.60 – 3.00	2.60 – 3.00	2.60 – 3.00
Acetate, works, bbl., lb.	.04½– .05	.04½– .05	.04½– .05
Bicarbonate, bbl., cwt.	1.75 – 2.00	1.75 – 2.00	1.85 – 2.00
Bichromate, casks, lb.	.06½– .07	.06½– .07	.06½– .07
Bisulphate, bulk, ton	15.00 –16.00	15.00 –16.00	15.00 –16.00
Bisulphite, bbl., lb.	.03½– .04	.03½– .04	.03 – .04
Chlorate, kegs, lb.	.06½– .06¾	.06½– .06¾	.06½– .06¾
Chloride, tech., ton	12.00 –14.75	12.00 –14.75	12.00 –14.75
Cyanide, cases, dom., lb.	.16½– .17	.16½– .17	.15½– .16
Fluoride, bbl., lb.	.07½– .08	.07½– .08	.07½– .08
Hyposulphite, bbl., cwt.	2.40 – 2.50	2.40 – 2.50	2.40 – 2.50
Metasilicate, bbl., cwt.	2.15 – 3.15	2.15 – 3.15	2.90 – 3.00
Nitrate, bags, cwt.	1.45 –.....	1.45 –.....	1.29 –.....
Nitrite, casks, lb.	.07 – .08	.07 – .08	.07½– .08
Phosphate, dibasic, bbl., lb.	1.70 –.....	1.70 –.....	.022– .024
Prussiate, yel. drums, lb.	.10 – .11	.10– .11	.11½– .12
Silicate (40° dr.) wks., cwt.	.80 – .85	.80 – .85	.80 – .85
Sulphide, fused, 60–62%, dr., lb.	.02½– .03½	.02½– .03	.02½– .03
Sulphite, cyrs., bbl., lb.	.02½– .02½	.02½– .02½	.02½– .02½
Sulphur, crude at mine, bulk, ton.	18.00 –.....	18.00 –.....	18.00– .....
Chloride, dr., lb.	.03 – .04	.03 – .04	.03½– .04
Dioxide, cyl., lb.	.07 – .08	.06½– .08	.07 – .07½
Flour, bag, cwt.	1.60 – 3.00	1.60 – 3.00	1.60 – 3.00
Tin Oxide, bbl., lb.	.60 –.....	.60 –.....	.49 –.....
Crystals, bbl., lb.	.40 –.....	.42 –.....	.35 –.....
Zinc. chloride, gran., bbl., lb.	.05 – .06	.05 – .06	.05 – .06
Carbonate, bbl., lb.	.14 – .15	.14 – .15	.09 – .11
Cyanide, dr., lb.	.36 – .38	.36 – .38	.36 – .38
Dust, bbl., lb.	.084–.....	.091–.....	.068–.....
Zinc oxide, lead free, bag., lb.	.06½–.....	.06½–.....	.05½–.....
5% lead sulphate, bags, lb.	.06½–.....	.06½–.....	.05½–.....
Sulphate, bbl., cwt.	3.15 – 3.60	3.15 – 3.60	2.65 – 3.00

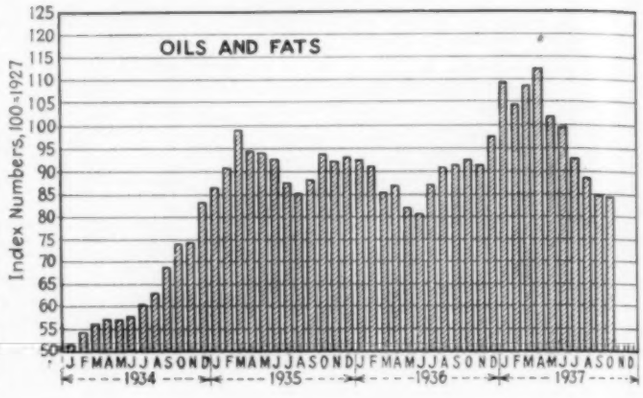
The accompanying prices refer to round lots in the New York market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to October 13

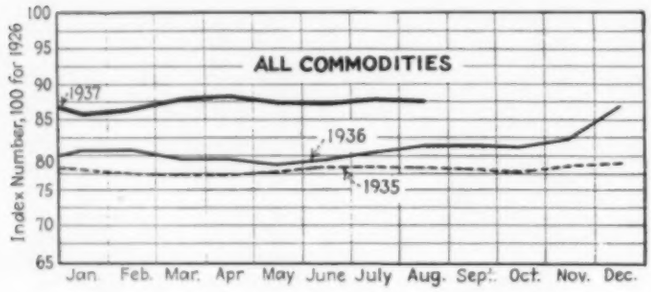
OILS AND FATS

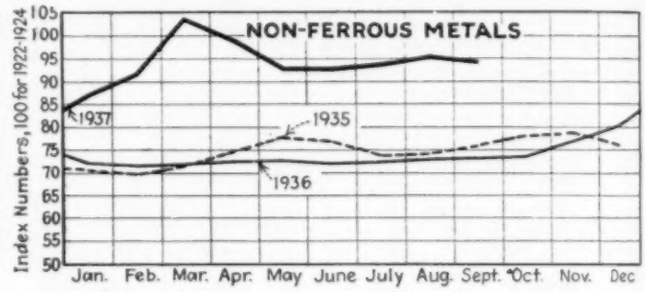
	Current Price	Last Month	Last Year
Castor oil, No. 3, bbl., lb.	$0.10½–$0.11	$0.10½–$0.11	$0.10 –$0.11
Chinawood oil, bbl., lb.	.25 –.....	.19 –.....	.14½–.....
Coconut oil, Ceylon, tanks, N. Y. lb.	.05 –.....	.04½–.....	.05½–.....
Corn oil crude, tanks (f.o.b. mill), lb.	.06¾	.07½–.....	.09½–.....
Cottonseed oil, crude (f.o.b. mill), tanks, lb.	.05¾–.....	.06½–.....	.08½–.....
Linseed oil, raw car lots, bbl., lb.	.11 –.....	.108–.....	.097–.....
Palm, casks, lb.	.05 –.....	.05 –.....	.05 –.....
Peanut oil, crude, tanks (mill), lb.	.06½–.....	.07½–.....	.08½–.....
Rapeseed oil, refined, bbl., gal.	.96 –.....	.95 –.....	.70 –.....
Soya bean, tank, lb.	.06½–.....	.07½–.....	.08 –.....
Sulphur (olive foots), bbl., lb.	.10 –.....	.10½–.....	.09½–.....
Cod, Newfoundland, bbl., gal.	.52 –.....	.52 –.....	.43 –.....
Menhaden, light pressed, bbl., lb.	.074–.....	.074–.....	.068–.....
Crude, tanks (f.o.b. factory), gal.	.35 –.....	.37½–.....	.30 –.....
Grease, yellow, loose, lb.	.05½–.....	.06½–.....	.06½–.....
Oleo stearine, lb.	.09 –.....	.09 –.....	.10 –.....
Red oil, distilled, d.p. bbl., lb.	.10½–.....	.10½–.....	.09½–.....
Tallow extra, loose, lb.	.07½–.....	.07½–.....	.06½–.....

CHEM. & MET.'S WEIGHTED PRICE INDEXES









COAL-TAR PRODUCTS

	Current Price	Last Month	Last Year
Alpha-napthol, crude, bbl., lb.	$0.52 -$0.55	$0.52 -$0.55	$0.60 -$0.62
Alpha-naphthylamine, bbl., lb.	.32 - .34	.32 - .34	.32 - .34
Aniline oil, drums, extra, lb.	.15 - .16	.15 - .16	.14½- .15
Aniline salts, bbl., lb.	.22 - .24	.22 - .24	.24 - .25
Benzaldehyde, U.S.P., dr., lb.	.85 - .95	.85 - .95	1.10 - 1.25
Benzidine base, bbl., lb.	.70 - .75	.70 - .75	.65 - .67
Benzoic acid, U.S.P., kgs., lb.	.52 - .54	.52 - .54	.48 - .52
Benzyl chloride, tech., dr., lb.	.25 - .27	.25 - .27	.30 - .35
Benzol, 90%, tanks, works, gal.	.16 - .18	.16 - .18	.16 - .18
Beta-napthol, tech., drums, lb.	.23 - .24	.23 - .24	.24 - .27
Cresol, U.S.P., dr., lb.	.12 - .13	.12 - .13	.10 - .11
Cresylic acid, 99%, dr., wks., gal.	.92 - 1.00	.92 - 1.00	.73 - .75
Diethylaniline, dr., lb.	.50 - .55	.50 - .55	.55 - .58
Dinitrophenol, bbl., lb.	.23 - .25	.23 - .25	.29 - .30
Dinitrotoluen, bbl., lb.	.15 - .16	.15 - .16	.16 - .17
Dip oil, 25%, dr., gal.	.23 - .25	.23 - .25	.23 - .25
Diphenylamine, bbl., lb.	.32 - .36	.32 - .36	.38 - .40
H-acid, bbl., lb.	.50 - .55	.50 - .55	.65 - .70
Naphthalene, flake, bbl., lb.	.07½- .07¾	.07½- .07¾	.07½- .07¾
Nitrobenzene, dr., lb.	.08 - .09	.08 - .09	.08½- .10
Para-nitraniline, bbl., lb.	.45 - .47	.45 - .47	.51 - .55
Phenol, U.S.P., drums, lb.	.14½-.....	.13½- .14	.14½- .15
Picric acid, bbl., lb.	.35 - .40	.35 - .40	.30 - .40
Pyridine, dr., gal.	1.55 - 1.60	1.55 - 1.60	1.10 - 1.15
Resorcinal, tech., kegs, lb.	.75 - .80	.75 - .80	.65 - .70
Salicylic acid, tech., bbl., lb.	.34 - .40	.34 - .40	.40 - .42
Solvent naptha, w.w., tanks, gal.	.30 -.....	.30 -.....	.26 -.....
Tolidine, bbl., lb.	.88 - .90	.88 - .90	.88 - .90
Toluene, tanks, works, gal.	.35 -.....	.35 -.....	.30 -.....
Xylene, com, tanks, gal.	.35 -.....	.35 -.....	.30 -.....

MISCELLANEOUS

	Current Price	Last Month	Last Year
Barytes, grd., white, bbl., ton.	$22.00-$25.00	$22.00-$25.00	$22.00-$25.00
Casein, tech., bbl., lb.	.13 - .14	.13 - .14	.17½- .18½
China clay, dom., f.o.b. mine, ton.	8.00 -20.00	8.00 -20.00	8.00 -20.00
Dry colors:			
Carbon gas, black (wks.), lb.	.04 - .20	.04 - .20	.04 - .20
Prussian blue, bbl., lb.	.37 - .38	.37 - .38	.37 - .38
Ultramarine blue, bbl., lb.	.10 - .26	.10 - .26	.10 - .26
Chrome green, bbl., lb.	.21 - .37	.21 - .37	.26 - .27
Carmine red, tins, lb.	4.00 - 4.40	4.00 - 4.40	4.00 - 4.40
Para toner, lb.	.75 - .80	.75 - .80	.80 - .85
Vermilion, English, bbl., lb.	1.75 - 1.80	1.75 - 1.80	1.59 - 1.60
Chrome yellow, C. P., bbl., lb.	.14½- .15½	.14½- .15½	.12 - .14
Feldspar, No. 1 (f.o.b. N.C.), ton.	6.50 - 7.50	6.50 - 7.50	6.50 - 7.50
Graphite, Ceylon, lump, bbl., lb.	.06 - .06½	.06 - .06½	.07 - .08½
Gum copal Congo, bags, lb.	.08 - .30	.08 - .30	.08 - .30
Manila, bags, lb.	.08½- .14	.08½- .14	.09 - .14
Damar, Batavia, cases, lb.	.16 - .24	.15½- .23	.15½- .16
Kauri cases, lb.	.18½- .60	.17½- .60	.19 - .25
Kieselguhr (f.o.b. N. Y.), ton.	50.00 -55.00	50.00 -55.00	50.00 -55.00
Magnesite, calc, ton	50.00 -.....	50.00 -.....	50.00 -.....
Pumice stone, lump, bbl., lb.	.05 - .07	.05 - .08	.05 - .07
Imported, casks, lb.	.03 - .40	.03 - .40	.03 - .35
Rosin, H., bbl.	8.80 -.....	9.15 -.....	7.25 -.....
Turpentine, gal.	.32 -.....	.35½-.....	.41 -.....
Shellac, orange, fine, bags, lb.	.22 -.....	.23 -.....	.25 -.....
Bleached, bonedry, bags, lb.	.17½-.....	.17½-.....	.18 -.....
T. N. Bags, lb.	.12½-.....	.12½-.....	.14½-.....
Soapstone (f.o.b. Vt.), bags, ton.	10.00 -12.00	10.00 -12.00	10.00 -12.00
Talc, 200 mesh (f.o.b. Vt.), ton.	8.00 - 8.50	8.00 - 8.50	8.00 - 8.50
300 mesh (f.o.b. Ga.), ton.	7.50 -10.00	7.50 -10.00	7.50 -11.00
225 mesh (f.o.b. N. Y.), ton.	13.75 -.....	13.75 -.....	13.75 -.....

INDUSTRIAL NOTES

MONSANTO CHEMICAL CO., St. Louis, has placed C. E. Ruth in charge of lampblack sales with headquarters at 30 Rockefeller Plaza, New York.

FULLER CO., Catasauqua, Pa., has appointed C. C. Kaesemeyer service engineer for the Pacific Coast with headquarters in the San Francisco office.

THE CRUCIBLE STEEL CO., Pittsburgh, has appointed Peter A. Frasse & Co., Inc., New York, as distributors of its high speed and tool steels in the New York, Philadelphia, Buffalo, Rochester, Syracuse, Jamestown, Hartford, and Baltimore districts.

ROOTS-CONNERSVILLE BLOWER CORP., Connorsville, Ind., has appointed W. E. Burke to handle sales of pumps in New England and Warren E. Quillman in Virginia, Delaware, Maryland, southern New Jersey, and eastern Pennsylvania.

CUTLER-HAMMER, Milwaukee, has opened a district office at 539 Gravier St., New Orleans, with Joseph Gardberg as manager.

G. WOOLFORD WOOD TANK MFG. CO., Darby, Pa., is occupying the new building which it erected for office purposes.

REPUBLIC STEEL CORP., Cleveland, through its subsidiary, Steel & Tubes, Inc., has opened an office in Baltimore with H. H. Smith in charge.

New CONSTRUCTION

Where Plants Are Being Built in Process Industries

	Current Projects		Cumulative 1937	
	Proposed Work	Contracts	Proposed Work	Contracts
New England	$50,000	$80,000	$1,535,000	$2,382,000
Middle Atlantic	490,000	775,000	16,152,000	16,126,000
South	250,000	200,000	25,595,000	32,773,000
Middle West	600,000	960,000	13,513,000	21,837,000
West of Mississippi	1,170,000	2,735,000	15,422,000	11,048,000
Far West	40,000	490,000	5,835,000	10,208,000
Canada	2,375,000	475,000	26,180,000	2,026,000
Total	$4,975,000	$5,715,000	$104,232,000	$96,400,000

PROPOSED WORK

Alkali Plant—Diamond Alkali Co., 630 Fifth Ave., New York, N. Y., has acquired a site at Carroll and Tonnele Aves. and Thorne St., Jersey City, N. J., and contemplates the construction of a plant for the Standard Silicate Division, 661 Tonnele Ave., Jersey City. Estimated cost will exceed $40,000. Maturity indefinite.

Chemical Factory—Harshaw Chemical Co., 1945 East 97th St., Cleveland, Ohio, plans to improve and enlarge its factory. H. E. Cowser, c/o Company, Engr. Estimated cost $500,000.

Factory—California Cotton Oil Corp., Coachella, Calif., contemplates repairs and alterations to its plant. Estimated cost $40,000.

Factory—Creo-Dipt Co., North Tonawanda, N. Y., plans improvements to its shingle staining and dipping plant. Estimated cost $40,000.

Factory—E. I. du Pont de Nemours & Co., Wilmington, Del., has acquired the plant at Fort Madison, Iowa, formerly occupied by the Perfection Tire Co. and plans to alter same for the manufacture of paint and enamel. Estimated cost $40,000.

Factory—Ruberoid Co., 500 Fifth Ave., New York, N. Y., has acquired the plant of the Gold Seal Asphalt Roofing Co. at Minneapolis, Minn., and plans to equip same for the manufacture and distribution of Ruberoid products. Estimated cost including equipment $40,000.

Fertilizer Factory—Rogers & Hubbard, Connecticut River East, Portland, Conn., plan to rebuild and replace the equipment in their plant which was recently destroyed by fire. Estimated cost $50,000.

Gas Plant—Owen Sound Public Utilities Comn., C. C. Middleboro, City Clk., Owen Sound, Ont., Can., plans to rehabilitate its existing gas plant or construct a complete new plant. Cyrie Tasker, Ontario Research Foundation, 42-47 Queens Park, Toronto, Ont., Engr. Estimated cost $175,000.

Laboratory—George S. Idell, Archt., 1512 Chestnut St., Philadelphia, Pa., is preparing plans for laboratory at 117-23 South Second St., Philadelphia, Pa., to be leased to General Dyestuffs Corp., 435 Hudson St., New York, N. Y. Estimated cost $50,000.

Laboratory—State Highway Dept., Jefferson City, Mo., is having plans prepared for the construction of a laboratory and office building on U. S. Rd. No. 50. Estimated cost $11,200. P.W.A. allotted $50,040.

Lead Smelter—National Lead Co., 111 Bway., New York, N. Y., will soon take bids for the construction of a lead smelter at Dallas, Tex. J. A. Caselton, 722 Chestnut St., St. Louis, Mo., in charge.

Lime Plant—West Virginia Farm Bureau Lime Committee, Leland Booth, Secy., Morgantown, W. Va., is interested in a project to construct an agricultural lime plant for the use of farmers in 35 counties. Estimated cost $200,000.

Paper Mill — Rushmore Paper Mills, Gouverneur, N. Y., plan to rebuild their paper mill which was recently destroyed by fire. Estimated cost $40,000.

Paper Mill—Howard Smith Paper Mills, Ltd., Montreal, Que., Can., are having plans prepared for an addition to their mill at Merritton, Ont. Estimated cost $200,000.

Paper Mill—Southern Kraft Paper Co., 220 East 42nd St., New York, N. Y., plans to construct an addition to its mill at Camden, Ark. Estimated cost $650,000.

Pulp Mill—Vermillion Lake Pulp Ltd., c/o A. H. Dowler, K. C., Fort William, Ont., Can., is having plans prepared for a pulp mill at Sioux Lookout, Ont. Estimated cost $2,000,000.

Refinery—Carle Gasoline Co., San Antonio, Tex., plans to enlarge and improve gasoline plant recently purchased from the Ranne Refining Co., on W. W. White Rd., San Antonio. Owners also plan to build a cracking unit. Estimated cost $80,000.

Refinery—Hambleton, Terminal Corp., River Rd., Tonawanda, N. Y., will soon receive bids for the construction of a cracking unit in connection with its $330,000 oil refinery. Estimated cost $280,000.

Refinery—Humble Oil & Refining Co., Corpus Christi, Tex., plans to construct a refinery at Ingleside, Tex. Estimated cost $250,000.

Refinery—Leonard Refineries, Inc., Alma, Mich., plans to construct an oil refinery and blending unit. Estimated cost $50,000.

Refinery—Phillips Petroleum Co., Bartlesville, Okla., plans to construct an additional tower at the Borger Refinery, Borger, Tex. Estimated cost $60,000.

Veneer Factory—Glanton Veneer Co., Whitesville, N. C., contemplates the construction of a veneer factory. Estimated cost $50,000. Maturity indefinite.

Warehouse—Pittsburgh Plate Glass Co., 3849 Hamilton Ave., Cleveland, O., has had plans prepared by Christian, Schwarzenberg & Gaede, Archts., 1836 Euclid Ave., for the construction of a warehouse and a top addition to its factory. $50,000.

CONTRACTS AWARDED

Abrasives Factory—Norton Co. of Canada, 3 Beach Rd., Hamilton, Ont., Can., has awarded the contract for the construction of a factory for the manufacture of abrasives to H. V. Poag, 9 Westinghouse St., Hamilton. Estimated cost $50,000.

Chemical Factory—Hockwold Chemical Co., 30 Bluxome St., San Francisco, Calif., has awarded the contract for additions to its plant on Mississippi St., to C. C. Newman, 507 Brannan St., San Francisco. Estimated cost including equipment $40,000.

Chemical Factory—Merrimac Chemical Co., Chemical Lane, Everett, Mass., has awarded the contract for an addition to its factory to Leonard Construction Co., 37 South Wabansia Ave., Chicago, Ill.

Chemical Plant—Virginia Carolina Chemical Corp., Richmond, Va., has awarded the contract for the construction of a chemical plant at Birmingham, Ala., to Leonard Construction Co., 37 South Wabash Ave., Chicago, Ill. Estimated cost $200,000.

Coke Ovens—Colorado Fuel & Iron Corp., Pueblo, Colo., has awarded the contract for the construction of a battery of 41 coke ovens to Koppers Co., Koppers Bldg., Pittsburg, Pa. Estimated cost $1,000,000.

Coke Plant—Semet-Solvay Co., Genesee Bldg., Buffalo, N. Y., has awarded the contract for the construction of a coke plant to Nicholson Co., 405 Lexington Ave., New York, N. Y. Estimated cost $100,000.

Factory—Hooker Electrochemical Co., Buffalo Ave., Niagara Falls, N. Y., has awarded the contract for an addition to its factory to John Smith & Son, 3420 Highland Ave., Niagara Falls, N. Y.

Glass Factory—Libbey Glass Co., Ash St. and Wheeling & Lake Erie R. R., Toledo, Ohio, has awarded the contract for a 4 story, 90x310 ft. factory to Austin Co., 16112 Euclid Ave., Cleveland, O. Estimated cost $500,000.

Glass Factory—Owens Illinois Glass Co., Ohio Bldg., Toledo, O., has awarded the contract for a glass factory and warehouse at Newark, O., to Hughes-Foulkrod Co., Koppers Bldg., Pittsburgh, Pa. Estimated cost $350,000.

Paint Factory—Pettit Paint Co., 45 Cornelison Ave., Jersey City, N. J., has awarded the contract for the construction of a factory to Thomas Greco, 65 Carmer Ave., Belleville, N. J. Estimated cost $45,000.

Paper Mill—Champion Paper & Fibre Co., Pasadena, Tex., has awarded the contract for a 125 ton capacity steel recovery unit on the Houston Ship Canal near Pasadena, Tex., to Babcock & Wilcox Co., 85 Liberty St., New York, N. Y. Estimated cost $800,000.

Pulp Mill—P. H. Gladfelter Co., Spring Grove, Pa., has awarded the contract for the construction of a pulp mill to H. J. Williams Co., Sumner St., York, Pa. Estimated cost $500,000.

Paper Mill—Nekoosa-Edwards Paper Co., Port Edwards, Wis., will construct an addition to its bleach plant. Work will be done by day labor. Estimated cost $65,000.

Pulp Mill—Puget Sound Pulp & Timber Co., Bellingham, Wash., has awarded the contract for the construction of a pulp mill to Howard S. Wright & Co., 2210 Second Ave., Seattle. Estimated cost $390,000.

Refinery—Barnsdall Refining Co. and Humble Oil & Refining Co., Corpus Christi, Tex., has awarded the contract for the construction of a refinery in the Flour Bluff field 12 mi. south of Corpus Christi to Petroleum Engineering Co., Inc., Tulsa, Okla. Estimated cost $275,000.

Refinery—Pontiac Refining Corp., Corpus Christi, Tex., has awarded the contract for a 4,000 bbl. gasoline refinery on a 40 acre plot near the Ship Channel and steel storage tanks to Mid-Continent Engineering Co., Dallas and Corpus Christi. Estimated cost $300,000 and $60,000 respectively.

Refinery—Quaker State Refining Co., W. H. Rockman, Supt. in charge, Farmers Valley, Pa., will construct a barrel house in McKean Co., Farmers Valley. Work will be done by day labor and separate contracts. Contract for fabricating the structural steel has been awarded to Keystone Engineering Co., Maloney Bldg., Pittsburgh. Estimated cost $50,000.

Rubber Factory—Goodyear Tire & Rubber Co. of Canada, Ltd., Lake Shore Rd., New Toronto, Ont., Can., has awarded the contract for the construction of a factory on Queen St., Bowmanville, Ont., to Austin Co., 355 St. Clair Ave., W., Toronto, Ont. Estimated cost $350,000.

Rubber Factory—Ohio Rubber Co., Willoughby, O., has awarded the contract for a 3 story addition to its factory to G. C. Rutland, Los Nation Rd., Willoughby. Estimated cost $45,000.

Rubber Factory—Thermoid Rubber Co., Trenton, N. J., has awarded the contract for an addition to its factory on Whitehead Rd to W. T. Wright Co., 101 North Broad St., Trenton. Estimated cost $40,000.

Sulphur Factory—Freeport Sulphur Co., Port Sulphur, La., and 122 East 42nd St., New York, N. Y., will construct a sulphur plant at Port Sulphur. Work will be done by day labor and separate contracts. Project has been in abeyance since 1936. Estimated cost $300,000.

Varnish Factory — Brandram-Henderson, Ltd., 6684 St. Urbain St., Montreal, Que., Can., has awarded the contract for an addition to its varnish factory to T. Holland, St. Urbain St., Montreal. Estimated cost $75,000.

Storage Sheds — Consolidated Chemical Industries, Inc., 111 Sutter St., San Francisco, Calif., has awarded the contract for storage sheds on Bayshore Blvd. to Barrett & Hilp, 918 Harrison St., San Francisco. Estimated cost $60,000.

Warehouse—U. S. Rubber Products, Inc., 355 Valley St., Providence, R. I., has awarded the contract for the construction of a warehouse to H. V. Collins Construction Co., 4 Westminster St., Providence. Estimated cost $40,000.

RISE IN PAINT AND RUBBER INDUSTRIES FAVORS LEAD AND ZINC PIGMENTS

SALES of domestic producers of lead and zinc pigments have been along a rising line following the low levels reached in 1932. In 1929 sales of white lead, zinc oxide, and lithopone reached a combined total of 541,106 short tons according to reports made by the U. S. Bureau of Mines. In 1932 the grand total of such sales dropped to 274,896 short tons or a decline of more than 49 per cent from the 1929 total. In 1936 sales had climbed to 453,031 short tons which was still more than 17 per cent below the figure for 1929.

The above comparisons clearly set forth the status of the lead and zinc pigment industry in 1936 as referred to the banner year of 1929. The figures however do not represent the entire pigment industry. In the last few years domestic production of titanium pigments has made rapid progress and estimates place titanium dioxide output in 1936 at 60,000 tons whereas the 1929 production was only about one-third of that amount. There also has been a trend toward larger use of zinc sulphide which means that lithopone is meeting with keener competition. If allowance is made for expanding sales of titanium oxide, pure zinc sulphide, and zinc sulphate, it is probable that there was very little change in the totals of all pigments sold in 1929 and 1936.

Again referring specifically to the lead and zinc pigments, it is found that the sharpest rate of decline in sales from 1929 to 1932 was charged against zinc oxide. Unfortunately a breakdown for consumption of zinc oxide by industries is not available for 1929. Census figures for 1929 credit consumption of zinc oxide in the rubber industry at 66,838 tons and in the paint industry at 55,603 tons. Consumption in the rubber industry is further broken down on a basis of 83 per cent in tires and inner tubes, 4 per cent in boots and shoes, and 13 per cent in miscellaneous rubber products.

For 1936 the 126,800 tons of zinc oxide sold was allocated as follows, rubber, 72,885 tons; paint, 33,149 tons; floor coverings, textiles, etc., 7,178 tons; cereamics, 6,102 tons; and other industries, 7,486 tons. Hence, last year the rubber industry absorbed more than 57 per cent of the zinc oxide sold, the paint industry, a little more than 26 per cent, floor coverings, textiles, etc., less than 6 per cent, and the remainder distributed among various industries.

Comparing 1936 with 1935, it is found that the floor covering and textile industries failed to increase their purchases of zinc oxide but increases in tonnage were reported of about 2,000 for ceramics, 8,000 for paint, and 15,000 for rubber but there was very little change in the percentage standings for the rubber and paint trades.

Distribution of 206,315 tons of lithopone in 1929 was on the basis of: about 73 per cent for paint, 18 per cent for floor coverings and textiles, 3½ per cent for rubber, and the remainder for miscellaneous uses. Since that year, the paint trade has increased its percentage ranking and in 1936 accounted for more than 77 per cent of domestic consumption of lithopone.

Consumption of white lead is predominantly in the paint industry with only about 5 per cent—less than 5 per cent in 1936—going to other industries. Yearly sales of white lead, therefore, will vary in direct proportion to the degree with which it maintains its popularity with paint manufacturers and to the yearly fluctuations in volume of paint output.

The above totals do not include the amounts sold each year to miscellaneous industries for which no detailed breakdowns are available.

Sales of White Lead, Zinc Oxide, and Lithopone

	White Lead dry short tons	White Lead in oil short tons	Zinc Oxide lead free short tons	Zinc Oxide leaded short tons	Lithopone short tons
1936	34,775	83,632	126,800	40,512	158,319
1935	27,972	68,859	99,697	29,976	159,486
1934	22,569	56,165	87,088	20,506	145,565
1933	24,628	48,354	98,542	22,868	140,831
1932	19,946	46,728	72,250	14,305	121,667
1931	30,922	66,446	95,700	18,577	131,850
1930	32,548	69,592	119,142	17,279	164,065
1929	42,159	104,872	160,611	27,149	206,315
1928	42,049	111,923	160,904	24,223	200,468
1927	38,669	119,026	151,246	26,064	176,994

Distribution of White Lead, Zinc Oxide, and Lithopone by Consuming Industries

	1936	1935	1934	1933	1932
Paint					
White lead	113,363	91,297	75,008	68,368	63,399
Zinc oxide	33,149	25,289	23,741	29,218	22,369
Lithopone	122,461	124,615	114,472	106,995	93,465
Totals	268,973	241,201	213,221	204,581	179,233
Rubber					
White lead	.....	.....	.....	.....	.....
Zinc oxide	72,885	57,734	50,145	53,869	37,679
Lithopone	4,908	4,435	4,596	5,078	3,955
Totals	77,793	62,169	54,741	58,947	41,634
Floor Coverings and Textiles					
White lead	.....	.....	.....	.....	.....
Zinc oxide	7,178	7,179	4,781	4,087	2,837
Lithopone	23,085	19,440	14,811	18,472	17,601
Totals	30,263	26,619	19,592	22,559	20,438
Ceramics					
White lead	2,653	1,834	1,434	1,617	1,761
Zinc oxide	6,102	4,028	2,963	2,639	1,782
Lithopone	.....	.....	.....	.....	.....
Totals	8,752	5,862	4,397	4,256	3,543

NEWS FROM WASHINGTON

(*Continued from page 630*)

federal hydro project. The only lively fish now on the government lines is the western phosphate proposal of Senator Pope. That gentleman proposes that with the assistance of T.V.A. electrochemical methods there should be established in Idaho a plant to process western phosphates. This would, he claims, deter those foreign representatives who "seek to monopolize the American phosphate business and resources."

During October it is expected that some tentative agreement will be reached between T.V.A. advisers and the spokesmen of Idaho, Utah, and Montana, who will have held several conferences to formulate the basis for such a plant. The next step then will be to seek funds from the President, by allotment from relief appropriations. If that fails, as Washington expects, the next step will be an effort to get appropriations from the states.

Certain western copper interests look at the project more than critically, because if consummated this plan would create a new supply of fertilizer phosphates in an area, remote from any market, which is already over-supplied by the "triple-super" made with by-product sulphuric acid from the smelting industry.

The special session of Congress opening Nov. 15 will stress crop control and wage-hour laws.